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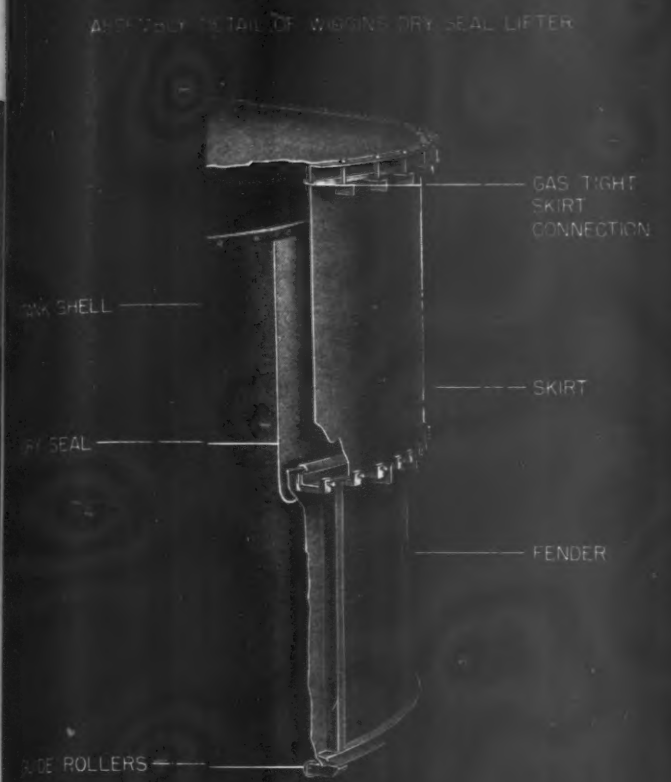

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RESEARCH

Such is the current demand for petroleum and its products that the oil industry is now producing and processing more crude oil daily than it did at the peak of wartime demand. The current consumption of petroleum products has exceeded by far all predictions of postwar demand. It now is estimated that the demand will continue to increase at a rate that in all probability will tax the industry's producing and refining facilities for some time to come.

It is a situation that constitutes a challenge to the industry. Apparently, it is not being overlooked; instead, there is evidence of some positive thinking having been done on remote future trends. Several of the larger oil companies have embarked or are embarking on long range programs of organized research. These are carefully planned programs of coordinated research that have as their ultimate objective: Improving the efficiency of oil exploration, drilling, producing, and refining operations. Reservoirs at great depth mean deep wells with their concomitant drilling and producing problems. The application of research in the solution of such problems is almost imperative in the interest of economy. Likewise, the processing of crude oil has become a highly technical and involved operation that has its problems. Here again, the application of research can aid in the solution of what may appear to be insuperable difficulties and so effect economies—substantial economies that can accrue from getting a larger and better product yield or from pointing the way to a more intelligent utilization of petroleum and its products.

This upsurge of interest in research by oil companies is significant. It ushers in a period of accelerated progress that may bring revolutionary changes in present field and plant practice.—K.C.S.

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SELECT CEMENT TO FIT THE JOB

SCANNING WASHINGTON'S OIL HORIZON

By MILBURN PETTY

WASHINGTON—Federal control of tidelands oil development appears likely now that President Truman has been elected for four more years and the Democrats, with many New Dealers back again, have recaptured control of Congress.

Development of offshore oil deposits is being strongly urged by the military and presidential advisers. This will require settlement of the federal vs. state control issue. Chances are remote that Congress would adopt a resolution quitclaiming these submerged lands to the states; and if so, Truman would veto it.

▸ **Tidelands.** A federal tidelands oil bill was introduced early last winter but was pigeon-holed by the Republican-controlled Congress in favor of the quitclaim resolution (which passed the House but never reached a vote in the Senate). This bill was—and probably still is—the embodiment of the Truman Administration's policies on tidelands oil. It was developed in a series of conferences among the Justice, Defense, and Interior departments and sent to Congress with a joint statement from Attorney General Clark and Secretaries Forrestal and Krug urging its enactment.

This bill proposed that there be set up a federal leasing system for offshore submerged lands, with federal leases exchanged for state leases except where it was decided that a particular tract should be withdrawn as a military oil reserve. Development of these leases would be strictly controlled, with production rates regulated. For administration of the proposed law, a Submerged Lands Commission would be established in the Interior Department.

The Truman Administration's tidelands bill was introduced by Senator Barkley, Kentucky, the new vice president, and by Congressman Celler, New York, who likely will be chairman of the House Judiciary Committee considering such legislation. Senator McCarran, Nevada, a strong advocate of quitclaiming the tidelands to the states, likely will return as chairman of the Senate Judiciary Committee but odds would be heavy against a quitclaim resolution.

Meanwhile, the Department of Justice has suits ready to file against Texas and Louisiana, claiming federal title to their offshore lands on the basis of the Supreme Court's decision in the California Tidelands Case.

▸ **Controls.** There is some sentiment in military quarters—and perhaps elsewhere within the Truman Administration—that the federal government should take positive steps to "conserve" U. S. oil resources for use in an emergency and utilize more foreign oil to meet our requirements, thus rebuilding a reserve crude productive capacity such as was available at the start of World War II.

Unless President Truman should adopt this view, the oil industry seems in no more danger of federal controls than most other industries that are essential to national defense and the public welfare.

▸ **Steel.** The industry most threatened with controls is steel. Voluntary allocation programs may take care of direct defense needs but they will take such a big bite out of the steel supply remaining for other requirements that there will be an increased howl for mandatory controls. Those complaints will fall on the receptive ears of the many New Dealers who will be back in Congress, beginning in January.

Within the Truman Administration, there has been a growing impatience with the steel industry for not adopting a voluntary allocation program to provide more steel for oil country tubular goods. But, even before the November 2 election, there were signs that the Steel Products Advisory Committee might reconsider its turndown of the tubular goods plan, thanks to persistent needling from the Interior Department, which argued that too much steel was finding its way into non-essential uses.

▸ **Gas Bill.** Since the 80th Congress was unwilling to pass the Moore-Rizley Gas Bill, circumscribing authority of the Federal Power Commission, it is a virtual certainty that the same bill would get nowhere with the incoming Congress. So, oil and gas producers may concentrate on an attempt simply to exclude the FPC from control of production and gathering operations.

Senator Murray (Dem., Montana), who will assume the reins of the Senate Small Business Committee, will be just as "tough" on the major oil companies as was Senator Wherry (Rep., Nebraska). Wherry was one of the few Republicans reelected to the Senate and there are some who say it was because of his championing of small business.

The oil industry's new found friend, Senator Malone (Rep., Nevada) won't be chairman of the Senate Natural Resources Subcommittee — but he will still be around. Whether Malone's oil hearings—planned for January—will be held, depends on Senator O'Mahoney (Dem., Wyoming) who again becomes the key senator on oil.

Congressman Wolverton (Rep., New Jersey) will step down as chairman of the House Interstate Commerce Committee but not before his group has filed its report on oil price policies.

▸ **Interior.** For months there has been talk that Interior Secretary Krug would be leaving the Cabinet to take one of several big industry jobs. If Krug goes, there is a good chance that he will be succeeded by Oscar Chapman, the Undersecretary, who came to Interior from Colorado in 1933. Chapman worked hard for Truman's nomination and election, and he was one of the few White House advisers who honestly believed that Truman had a chance to beat Dewey. Truman seldom forgets his friends. But, because of that very characteristic, the name of Mon Wallgren, a former senatorial pal of Truman's must be considered. Wallgren was defeated for governor in Washington.

Replacing Max W. Ball as director of Interior's Oil and Gas Division won't be easy. Likely prospects from the oil industry have rather decided opinions on the tidelands issue—and many have not hesitated to express themselves as against federal control. (Ball, who is slated to leave December 1, always managed to avoid stating his views on the tidelands issue.)

▸ **Divorcement.** Disintegration of the major oil companies, breaking them down into separate companies in each branch, is likely to become a lively issue again in the new Congress.

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highlights in oildom

Sun's James E. Pew pointed out a fact that needs much repetition—people pay lower prices for natural gas used in their homes because of the ingenuity of natural gas companies and not because of government controls. In a speech before the Independent National Gas Association, Pew ridiculed claims made occasionally by members of Federal Power Commission that users of natural gas have been "saved" large sums of money as a result of FPC regulations.

Technological advancements and acquiring markets for surplus gas during low consumption periods have cut costs, Pew maintained. Without these economic moves FPC could regulate until doomsday without bringing prices down, he said.

Phillips 35 cents a barrel price increase for crude oil was explained by President K. S. Adams to company employes in the November *Philnews*. Reminding them that shortages last winter and this summer required allocations of petroleum products, he goes on, "This nip-and-tuck struggle between supply and demand caused much talk of higher prices to stimulate crude oil discoveries. Now it seems the industry is lulling itself into an attitude of complacency merely because an apparent balance between supply and demand has developed in recent weeks. To reach this apparent balance, the industry used its remaining reserve producing capacity, engaged in wasteful and uneconomic practices and increased imports to peak figures. This course, if continued, would inevitably react unfavorably on the industry, the consumer and the nation in its new role as world leader."

In his contention that present crude oil price increases are less than average, Adams quotes the following table:

From WHOLESALE COMMODITY PRICE INDEX	Increases of August 1948 Prices over 1946 Prices
Lumber	218.2%
Bituminous coal	94.5%
All raw materials	82.0%
Structural steel	78.8%
Motor vehicles	74.2%
Iron and steel	62.3%
Petroleum and products	22.1%

Profits continue high and there is a growing political section that apparently thinks it is a sin to make good profits. S. A. Swensrud, president of Gulf Oil, stated recently that despite high paper profits, *real* profits last year were substantially below those of 1937. To demonstrate he used figures of 17 large companies. For 1947 profits were $1,109 million, of which $391 million was paid in dividends and about $718 million was reinvested. But last year cost-of-living index was 54 per cent above 1937 so buying power of the dividends was only $252 million. Construction costs rose 215 per cent in the preceding 10 years so the capital investment would buy only $330 million worth of new facilities at 1937 prices.

In 1937 profits of the 17 companies were $544 million. After investments had been increased 50 per cent over 10 years, the 1947 profits had a 1937 purchasing power of only $582 million. As the man said, *less than in 1937*.

The oil shortage may not be over, Albert J. McIntosh, Socony-Vacuum economist, told business men recently. Although stocks are better than a year ago, unlimited quantities of all kinds of oil are not available. Such a small margin of safety exists in supply that it could easily be upset. McIntosh reminded his audience that the average American used 30 times as much petroleum a year as the average person in the rest of the world.

The death of 19 persons in Donora, Pennsylvania, from smog lays new stress on research on fume and smoke control by the petroleum industry.

W. L. Stewart, Jr., chairman of Western Oil and Gas Association smoke and fumes committee, says that despite the largest program of scientific research on smog ever undertaken it is doubtful if the real cause has yet been discovered. The oil industry has intensified its study of the condition and in California major oil refineries have:

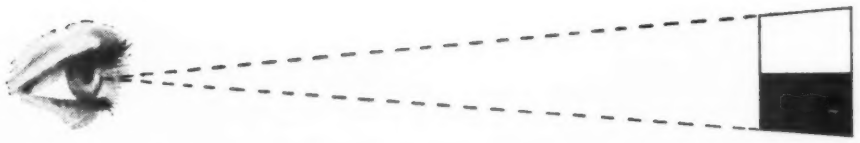
1. Ceased burning acid sludge, causing a major reduction in the production of sulphur dioxide.

2. Switched from fuel oil, which contains sulphur, to natural or refinery gases for the operation of refineries.

3. Processed refinery gases to remove mercaptans, sulphur compounds that formerly escaped into the air.

4. Processed refinery gases to remove hydrogen sulphide.

***FIRST OIL IN NORTH AMERICA** was reported at the Seneca oil spring near Cuba, New York, in 1627 by Franciscan Friar Joseph de la Roche D'Allion. On Oil Progress Day Chief Curry and Robert Sivihart, Seneca Indians, pointed out the site to Mayor Charles H. Artzburger of Cuba and Father Irenaeus Herscher of St. Bonaventure College.*



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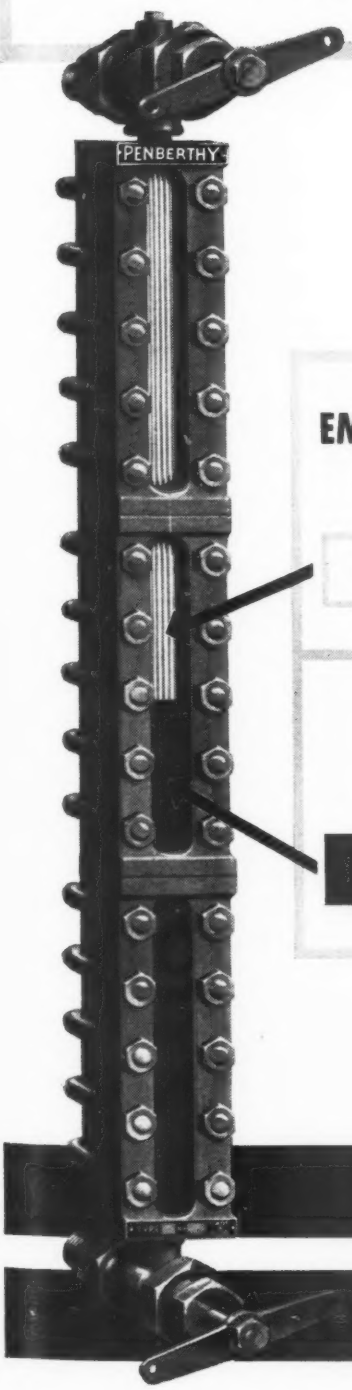

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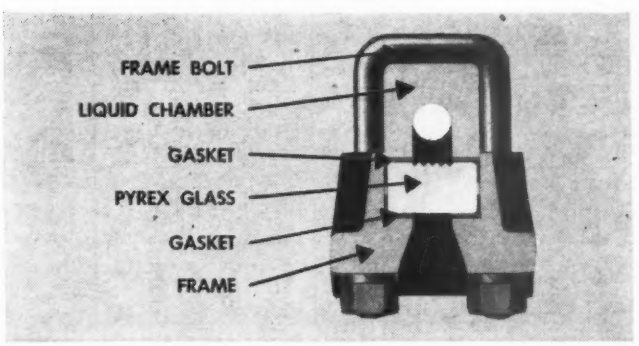

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DROP FORGED STEEL · LIQUID LEVEL GAGES

national petroleum situation

By H. J. STRUTH*,
Petroleum Economist

▸ **Price and Reserves.** Regardless of what action is taken with respect to the price of crude, the facts prove that higher oil prices have definitely resulted this year in the discovery of far more reserves than were found at lower price levels. Preliminary studies indicate the likelihood that this year's oil discoveries will approach the peak of 1937. When this year's results are computed in barrels, credit for the industry's success will be attributed to price incentives that made it possible. If major crude buyers accept a 35-cent increase it will have to be absorbed; it cannot be passed on to consumers.

*Editor, *The Petroleum Data Book.*

▸ **Refining Situation Improved.** Gradual resumption of refinery operations in California and settlement of labor dispute brought considerable improvement in the national refining situation. Still runs in October rose about 288,000 bbl daily to a national daily average of 5,581,000 bbl. Cumulative runs this year have averaged 5,509,000 bbl daily, against 5,025,000 bbl last year, a net increase of 10 per cent, despite the slow-down in California.

▸ **Marked Supply Gain.** Marked improvement in the oil supply picture is shown by the increase in stocks of all oils this year of 84,234,000 bbl, which compares with an increase during the same period of last year of only 7,147,000 bbl. Cumulative demand this year has been at the daily rate of 6,069,000 bbl, while supply of all oils averaged 6,345,000 bbl. Last year, demand averaged 5,804,000 bbl, while supply was at the daily rate of 5,828,000 bbl. Crude production is 9 per cent greater; imports are up 11 per cent; natural gasoline output is greater by 10 per cent and refinery still runs are 10 per cent above last year.

▸ **No Fuel Shortage.** Fuel oil stocks are 33 per cent above a year ago. The increase in stocks during October was 10,000,000 bbl and lifted stocks of November 1 to 154,250,000 bbl, against 115,754,000 bbl last year. Many consumers still fear a serious fuel shortage this winter; do not know remarkable success that has attended industry's efforts to prevent one. Facts relating to vastly improved supply situation would dispel public apprehension engendered by shortage predictions publicized by governmental agencies.

Comparative Statistics, October, 1948

*All figures are computed on a Bureau of Mines' Basis**

	October 1948℗	Sept. ¶ 1948℗	October 1947	This year to date	Last year to date	Per cent change
Wells drilling	4,850	4,870	4,650	4,850	4,650	+ 4
Total wells drilled	3,610	3,607	3,137	31,887	27,379	+16
Development wells	2,813	2,858	2,400	24,970	21,317	+17
Oil	1,922	1,956	1,612	17,287	14,266	+21
Gas	260	247	301	2,125	2,661	—20
Dry	631	655	487	5,558	4,390	+27
Per cent dry	22.4	22.9	20.3	22.3	20.6	+ 1.7
Service wells	170	193	237	1,725	1,808	— 5
Wildcat wells	627	556	500	5,192	4,254	+22
Oil	86	76	75	793	678	+17
Gas	21	21	21	215	170	+26
Dry	520	459	404	4,184	3,406	+23
Per cent dry	82.9	82.6	80.8	80.6	80.1	+ 0.5
Crude supply*	184,600	172,580	172,674	1,766,896	1,612,960	+10
Daily average	5,955	5,753	5,570	5,793	5,306	
Crude demand‡	181,900	167,800	171,185	1,758,116	1,611,195	+ 9
Daily average	5,868	5,593	5,522	5,764	5,300	
Crude stocks	239,430	236,730	231,941	239,430	231,941	+ 3
Days supply	41	42	42	41	42	
Natural gasoline production	12,000	11,250	11,635	118,073	107,792	+10
Daily average	387	375	375	387	355	
Motor fuel production	78,900	73,670	75,656	758,767	692,685	+10
Daily average	2,545	2,456	2,440	2,488	2,279	
Gasoline yield, per cent	40.6	41.3	41.2	40.1	40.2	— 0.1
Motor fuel demand‡	77,100	78,970	77,063	756,251	703,487	+ 8
Daily average	2,487	2,632	2,486	2,480	2,314	
Motor fuel stocks△	90,000	88,200	78,931	90,000	78,931	+14
Days supply	36	34	32	36	32	
Fuel oil production	71,750	62,200	68,138	699,525	623,865	+12
Daily average	2,315	2,073	2,198	2,294	2,052	
Fuel oil demand‡	69,000	58,610	71,248	714,686	687,877	+ 4
Daily average	2,226	1,954	2,298	2,343	2,263	
Fuel oil stocks	154,250	144,000	115,754	154,250	115,754	+33
Days supply	69	74	50	69	50	
Refinery still runs	173,000	158,790	162,854	1,680,250	1,527,669	+10
Daily average	5,581	5,293	5,253	5,509	5,025	
All refined stocks	345,600	331,200	282,300	345,600	282,300	+23
Days supply	59	58	47	59	47	

Supply and Demand—All Oils

	October 1948℗	Sept. 1948℗	October 1947	This year to date	Last year to date	Per cent change
Total supply, all oils	201,400	188,660	189,116	1,935,178	1,771,648	+ 9
Daily average	6,497	6,289	6,101	6,345	5,828	
Total demand‡, all oils	184,300	173,320	188,196	1,850,944	1,764,501	+ 5
Daily average	5,945	5,777	6,071	6,069	5,804	
Change in stocks	+17,100	+15,340	+920	+84,234	+7,147	

Current Crude Oil Prices

U. S. average	$2.61	Louisiana	$2.62
Texas	2.61	Arkansas	2.43
California	2.42	New Mexico	2.40
Oklahoma	2.63	Mississippi	2.42
Kansas	2.62	Illinois	2.76
		Other states	3.15

Basic crude prices:

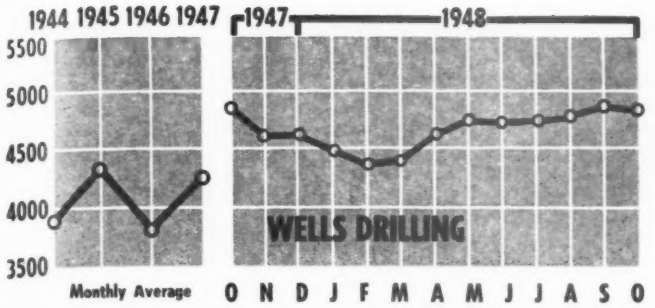
Oklahoma-Kansas (36 gr.)	$2.57
Texas Gulf Coast (36 gr.)	2.86
East Texas	2.65
West Texas (36 gr.)	2.44
California Signal Hill (26 gr.)	2.41
Pennsylvania, Bradford	5.00

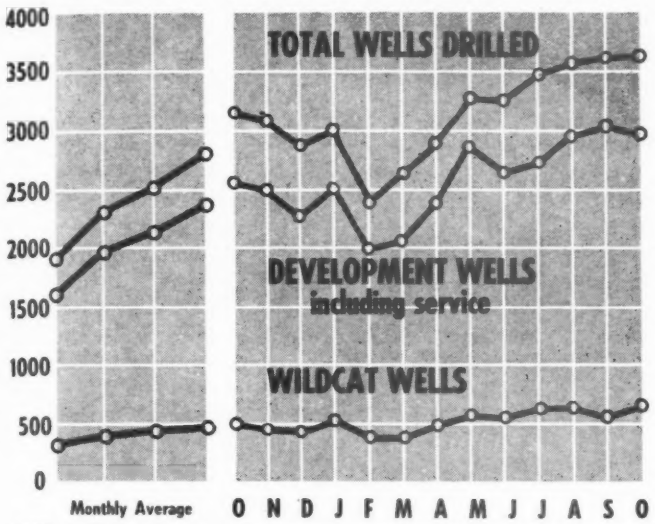
Drilling and Production Statistics by States

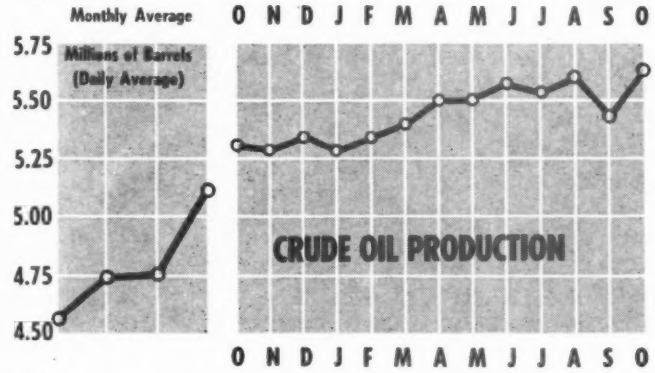
	October 1948℗	Sept. 1948℗	October 1947	This year to date	Last year to date	Per cent change
Wells drilled (excl service)	3,440	¶3,414	2,900	30,162	25,571	+18
Arkansas	33	31	40	260	265	— 2
California	239	225	211	2,373	1,658	+43
Illinois	269	235	190	2,008	1,681	+19
Kansas	309	290	292	2,580	2,136	+21
Louisiana	222	225	184	1,919	1,325	+45
Mississippi	38	37	48	343	416	—18
New Mexico	50	45	44	496	457	+ 9
Oklahoma	400	370	331	3,446	3,209	+ 7
Texas	1,105	¶1,198	765	9,944	7,730	+29
Other states	775	758	795	6,792	6,694	+ 1
Wildcats drilled (incl above)	627	556	500	5,192	4,254	+22
Arkansas	9	6	9	83	58	+43
California	58	44	34	394	288	+37
Illinois	53	41	34	364	360	+ 1
Kansas	63	39	40	432	336	+29
Louisiana	31	21	25	249	236	+ 6
Mississippi	12	11	9	88	80	+10
New Mexico	7	4	5	51	40	+28
Oklahoma	73	69	86	685	708	— 3
Texas	225	223	180	2,098	1,535	+37
Other states	96	98	78	748	613	+22
Daily crude production	5,620	5,419	5,320	5,472	5,039	+ 9
Arkansas	86	87	85	86	81	+ 6
California	933	781	921	926	909	+ 2
Illinois	181	182	181	176	183	— 4
Kansas	302	302	301	300	288	+ 4
Louisiana	497	498	456	489	433	+13
Mississippi	129	129	107	124	94	+32
New Mexico	133	132	123	130	111	+17
Oklahoma	433	429	406	416	383	+ 9
Texas	2,527	2,484	2,378	2,450	2,220	+10
Wyoming	161	158	131	149	118	+26
Other states	238	237	231	226	219	+ 3

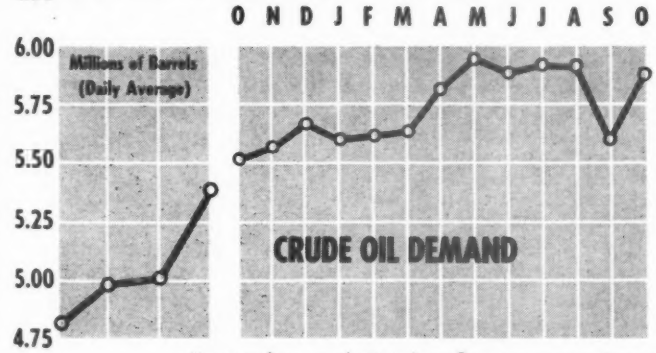
*Unless otherwise stated all figures represent thousands of barrels. ℗–Preliminary. •Includes domestic production and imports.
‡Total demand, including exports. △Includes finished and natural gasoline. ¶Revised.

Preliminary estimates based upon data supplied by American Petroleum Institute, U. S. Bureau of Mines, State Agencies, and other official sources.

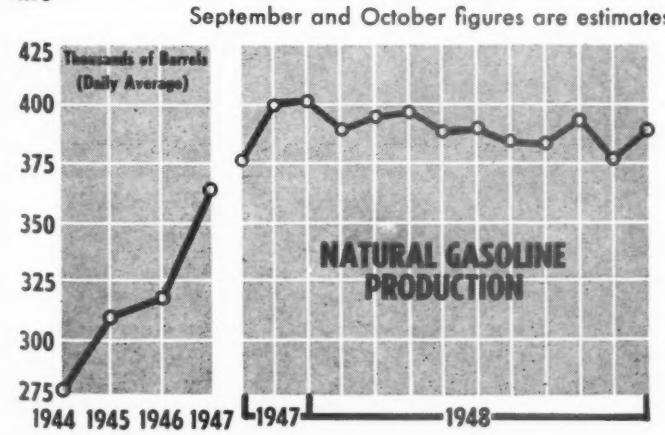


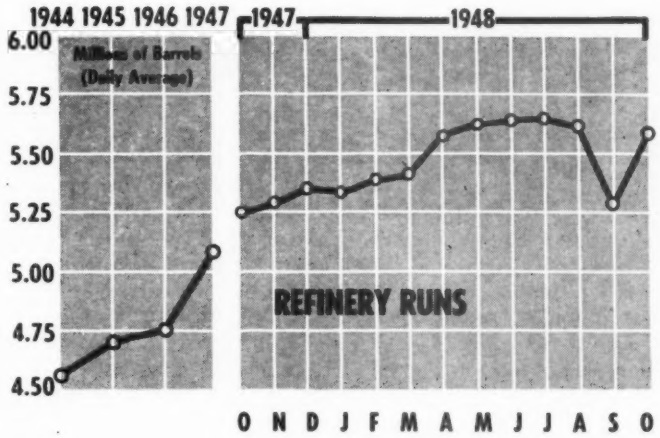


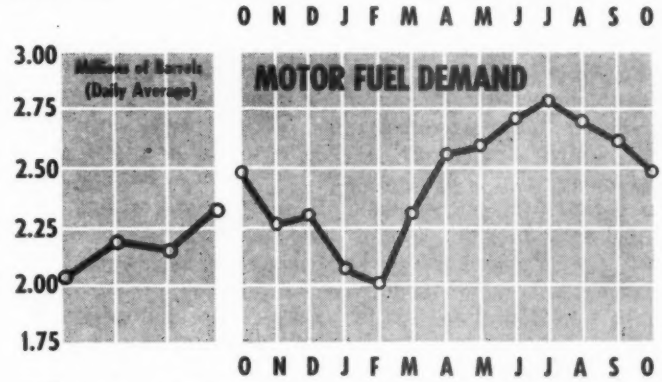


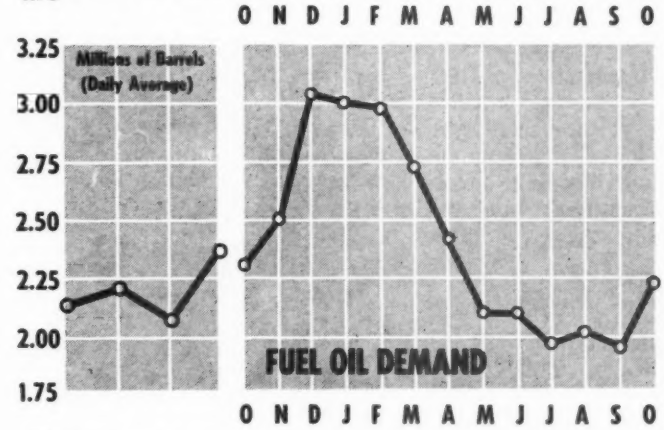


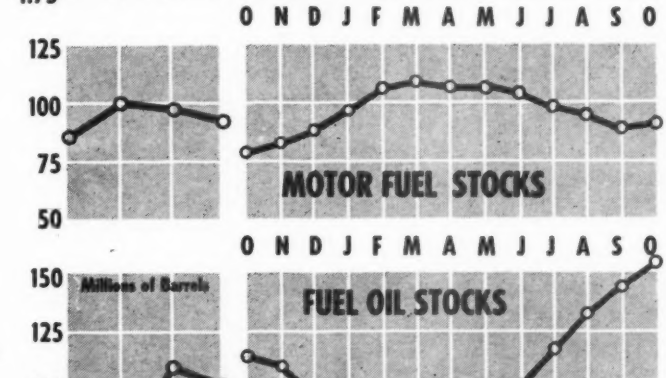
September and October figures are estimates.

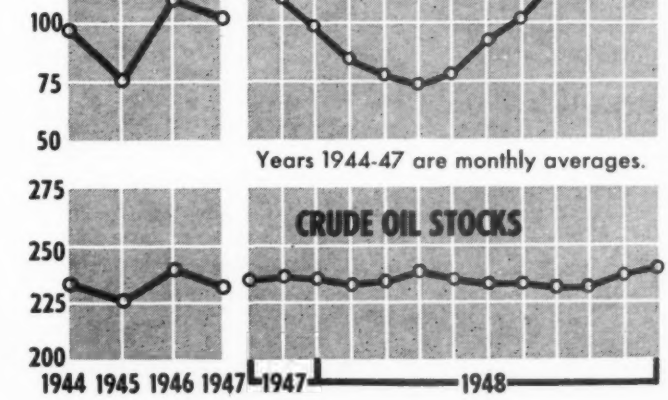












PETROLIC PERSONALITIES

DICK SNEDDON

AS WE WRITE this inconsequential opus, Nick Lanyi, engineer in the natural gas department of the Magnolia Petroleum Company at Dallas, and Mrs. Lanyi, have just returned from an enjoyable vacation in his native Hungary, where they visited long neglected relatives. While they were gone, Nick kept The Petroleum Engineer well apprised of their European perambulations by means of a series of interesting picture postcards. One, for example, showed a rocky promontory in Interlaken, and bore some script in Nick's neat hand, reading, "This is the rock from which the ancient Swiss used to hurl their enemies. Wish you were here." Several showed street scenes in Paris, with the natives as usual devouring fricasseed frog legs, or throwing each other about in a frenzy of apache dancing. Another was a shot of a street scene in Venice, which would indicate that the sewers are still stopped up—at least, the place is just as badly flooded as it was when we were there years ago. Then there were photos of Budapest and Prague—the latter, incidentally, is pronounced Pra-ha, but we haven't even a vague, or va-ha idea of why this should be. Anyway, the staff much enjoyed these colorful progress reports, and are right pleased to learn that all the Lanyi kin over yonder are in the physical pink. And, just by way of a checkback, it might be mentioned that before the war, Nick was assistant manager of production in Egypt, but has been with Magnolia since about 1940. We hear tell that the Dallas Petroleum Engineers' Club is all of a twitter—awaiting an illustrated lecture on this most recent Lanyi tour.

ED BORYS, another geologist of repute, once superintendent of exploration for Standard of Cal in West Texas, and more recently assigned to a foreign subsidiary of the company, with headquarters in New York, joined the Hunt Oil Company in Texas on November 1, 1948. Ed was born in Minneapolis; speaks Swedish with a slight American accent; is a graduate of the University of Minnesota and California Institute of Technology; and has been engaged in geological and geophysical work since 1936. He loves to play golf, and practices every chance he gets, which is not too often. One Saturday, however, he worked so arduously on his follow through that he later got in his car to go home and drove three miles past the house. He has played the famed Cloudcroft Course which is 9000 feet up in the air, or about 3000 feet less than the average golfer. He can also be very easily lured out into mountains on a fly fishing expedition, although what fun anyone finds in fishing for flies is something we have never quite understood. Ed's other hobby is duck hunting—at least he thinks it would be if he could ever get an opportunity to try it.

PAUL WEAVER, geological director of the Gulf Oil Corporation, Houston, Texas, was a guest speaker at the AAPG Pacific Section annual meeting, out at the Huntington Hotel, Pasadena, California, a short time ago, and he proved to be a very lucid gentleman, indeed, with a lot of good ideas and a rare sense of humor. He remarked among other things that it was fortunate so many dry holes were being drilled in Louisiana, because there was no pipe with which to complete producing wells anyway. He was also tickled no end at the reckless manner in which the young geologists of the West bandied about that abstruse term "subjacent." He had noted that in the first few papers delivered it had occurred rather frequently. The amazing thing to this observer is not that the word was used, *but that Mr. Weaver noticed it*. The peculiar lingo of the geologist is so cluttered with jaw breakers, that at a geological convention one would expect such a word as "subjacent" to be lost in an avalanche of polysyllabics. However, the speaker had sort of picked it out with a pair of metaphorical forceps, presented it with tongue in cheek to his own audience, and made a lot of fun out of the gesture. Mr. Weaver, if we understood correctly, suggested as a worthwhile project for the Association an examination of the petroleum industry's entire core sampling and disposal system. He estimated that Texas alone took about two million feet of cores a month, and strongly urged that some effort be made to determine what portion of that footage should be preserved for possible future investigation; how and where it should be kept, and whence is to be procured the wherewithal to finance all of this. Which should keep all you pebble pups busy while we search the derrick groves for further scandal.

ONE of the saddest events of which we have heard in a long, checkered life that has been simply bulging with sadness, involves that worthy soul, Dick Bright. Dick, well known evaluation engineer of the Mercantile Bank of Dallas, packed his grip with some strong binoculars a while ago, and hied off to Atlantic City, hoping to do a bit of private judging in the Miss America contest. But, to his profound chagrin, by the time he got there, the contest was over, the girls were gone, and all he could do was evaluate some rather ordinary looking scenery. We understand that following this disappointing experience in Atlantic City, he developed a bored walk, and has had to take some extra time off to vituperate. We also understand that Mrs. Bright not only went along to Atlantic City with him, but had something to do with arranging the trip. Could there be any relation between this latter circumstance and the fact that Dick missed the beauty contest? Perish the thought or something-

STILL waxing geological, we reach up into the higher strata of the Houston intelligentsia for our next victim, one L. W. "Doc" Blau, to whom we award an oratorical oscar for his research in the medical field, as well as his continued effort to uplift the standards of his profession. Doc was born in central Texas of German forbears, and still gives a slight but intriguing Teutonian twist to his version of the soft Texas drawl. He is a graduate of University of Texas in physics; once directed geophysical and exploration research for Humble Oil Company, and is now research consultant on exploration, drilling and production for Humble and Standard of New Jersey. Doc has in a very large way been responsible for the medical research that is now being conducted on the use of inositol to check diabetes and hardening of the arteries with which it is commonly associated. In a long article, the Wall Street Journal recently gave him credit for doing the pioneer work along this line. He has a brilliant mind, and being strictly scientific adds no floss to his verbiage. A spade is a spade, and when the occasion warrants, he whips the geological boys to greater deeds of

derring do with lashes of words that are well knotted with bits of biting sarcasm. He berates them as "mental bankrupts"—and they love it. In fact, he is one of the most popular speakers in the Mid-Continent area. He is also one of the most tireless workers, and in every respect is a credit to the petroleum industry and his profession.

ROLAND GOULDY, petroleum engineer and lease man for Joe Bridwell, independent contractor and producer of Wichita Falls, is busier than the proverbial bird dog, learning to put three-cornered suits on the recently arrived scion of the House of Gouldy, to wit—James Martin. From all accounts, this junior edition is giving Roland more work than the chairmanship of the North Texas chapter of API, and he is terrifically surprised to find that while the baby is a delicate pink most of the time, it occasionally becomes a robust yeller. Compared with Fred Neslage, pool engineer of the Pampa Re-Pressuring Association, however, Gouldy Senior is a rank amateur. The Mons Neslage has a brood of six children, just three short of a baseball team, and it may be of some significance that he was once a football tackle. It is certainly significant that he is a leading authority on production, *oil production, that is*—and please don't interrupt! He recently made an interesting talk to the North Texas API and AIME on how he raised the oil yield of the Pampa project some 2000 bbl a day, which is a mighty nice idea if you can do it.

SURE enjoyed Sam Bowlby's party at the Town House in Los Angeles, during the AIME Fall Meeting. Sam, Shell Oil Company's vice president in charge of Southern California operations, was general chairman of the meeting this year, which pretty well guaranteed its being a success. Getting back to the cocktails, it was a bit coolish out on the patio of the swanky Wishire jernt at first, but it didn't take the oil chappies long to warm the place up. Sam did an excellent job of hosting the affair, and everyone seemed to be having a good time. Hovering always in the background we noted undercover man, Oscar Shove, the San Marino thrush, who sings on the slightest provocation, and between stanzas does a neat job of officiating as public relations rep for Shell Company in the southern division. There were so many petrolic men about town at this dispensary of liquid sunshine that we hesitate to name any, but in the interest of the good neighbor policy, we might remark briefly that we met Juan Pedretti, looking like a million plus—still studying oil methods with Union Oil Company, and still hoping that one of these days the Paraguayan Chaco may be the scene of an oil discovery.

CHESTER BURNS, export representative for National Supply Company, with headquarters in New York, is another recent visitor on the West Coast. Chet, whose territory is all traversable land outside of the United States, is wintering here, meantime improving the shining hour by taking training courses at Fluid Packed Pump Company of Los Nietos, and The Stoody Company of Whittier, after which he will dash down to South America and sundry other foreign parts, extolling the virtue of his wares. It is his intention, however, in order to still further advance his education, to attend the opening of Santa Anita and see the Rose Bowl game before he leaves California. We hate to dampen Chet's enthusiasm but we once accepted an invitation to Santa Anita and have never been quite the same since. A nice looking chap, for a sizable consideration, tipped us off to a sure winner. He even claimed to be a relative of the horse, but we suspect he was only related to part of it. Anyway, we bet heavily, for us, on his selection—$4.00 on the schnozzola. The animal started at

speed nuts simplify renewal of

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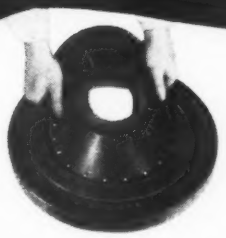

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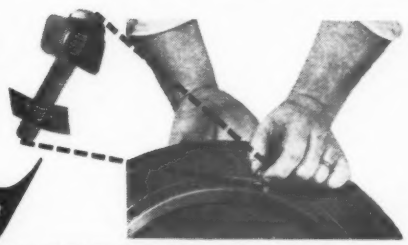

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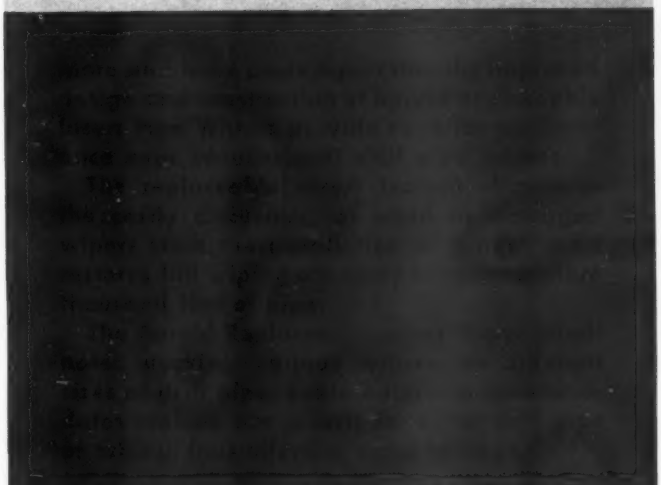

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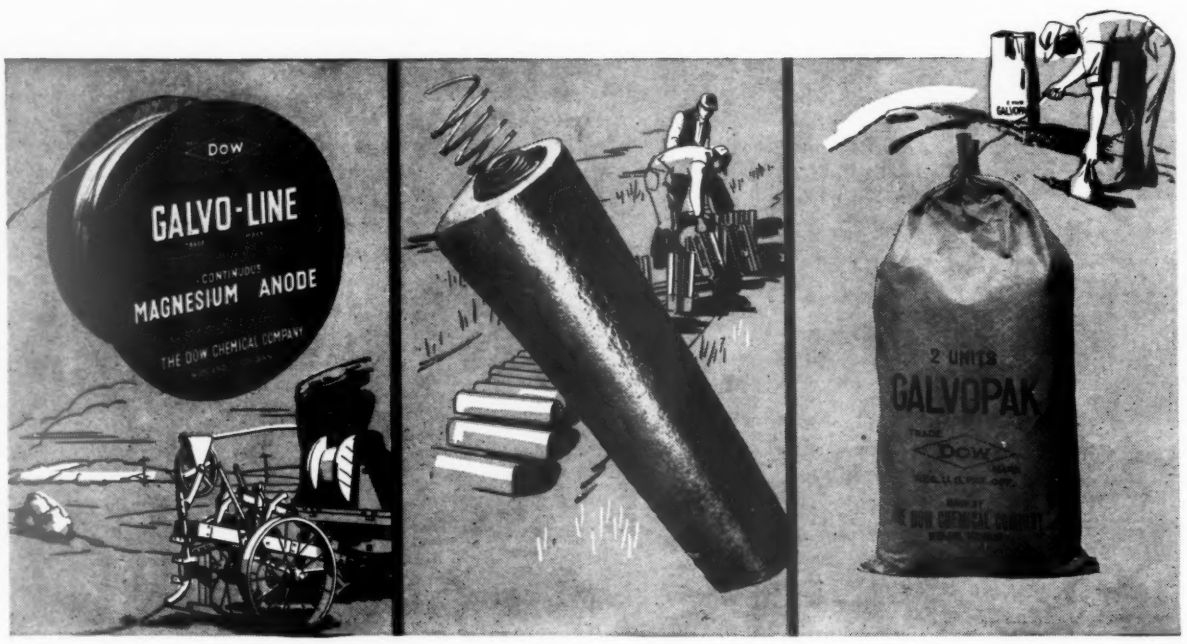

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20 to 1, and to our intense disgust never got back until half past three. A low blow, by jinks, if we ever saw one!

Streamlined Magazine

The four Petroleum Engineer magazines to be published beginning January, 1949, will be:

1. *The Petroleum Engineer*—all divisions. This will include all sections.
2. *The Petroleum Engineer Exploration, Drilling, and Production Magazine,* which will include the first two sections.
3. *The Petroleum Engineer Refining and Gas Processing Magazine, which will include General Section and Refining and Gas Processing section.*
4. *The Petroleum Engineer Pipe Line and Marine Transportation Magazine, the General Section and Pipe Line and Marine Transportation Section.*

Now for a last minute roundup of the news; Jim Moon, the Waldrip design engineer and expert on fishing tools—trout fishing that is, was in Dallas recently. He will do New York and the API at Chicago before returning to his desk in Hollydale. Martin Van Couvering took his friend "Lev" Levorsen down to Newport Beach to see Paul Paine, well known evaluation expert and historical writer, and thence they dropped by Palomar for a look at the big lens. Lev, dean of the School of Mining Science at Stanford University and exprexy of the G.S.A., is flying to New York pronto for the annual meeting of the Society there. Incidentally his speech delivered at Ottawa last year was regarded so highly it is to be published for wide distribution. Bill Kleinpell has just been elected a director of the Kern County Land Company. Bill is known as the dean of the Bakersfield geologists—a well earned title—and can beat the feathers off a badminton birdie faster than Dave Freeman. Ted Lynton is back from a six weeks' sojourn in France, looking as chipper as ever. We missed Gordon Bell like everything at the AAPG meeting this year. It didn't seem right without Gordon around, and we certainly hope he recovers from his illness soon and completely. H. C. "Woody" Wood of Grove Regulator Company has a nice bit of property up in the Cuyama field, and Milt Lewis is more than casually interested in Guijarral Hills. All of which ends another highly educational session. Remember, all work and no play makes a man a production foreman.

* * *

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WHAT A MOVEMENT!

THE PLAY OF THE YEAR

As the ball is snapped, a "pure T" formation suddenly breaks into a "Goldberg Dervish," with each back apparently spinning in a spiral or "helix." Baffling, confusing—effective!

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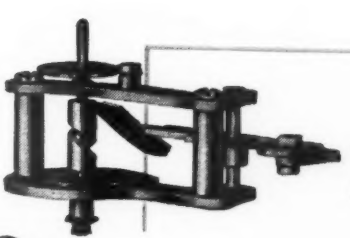

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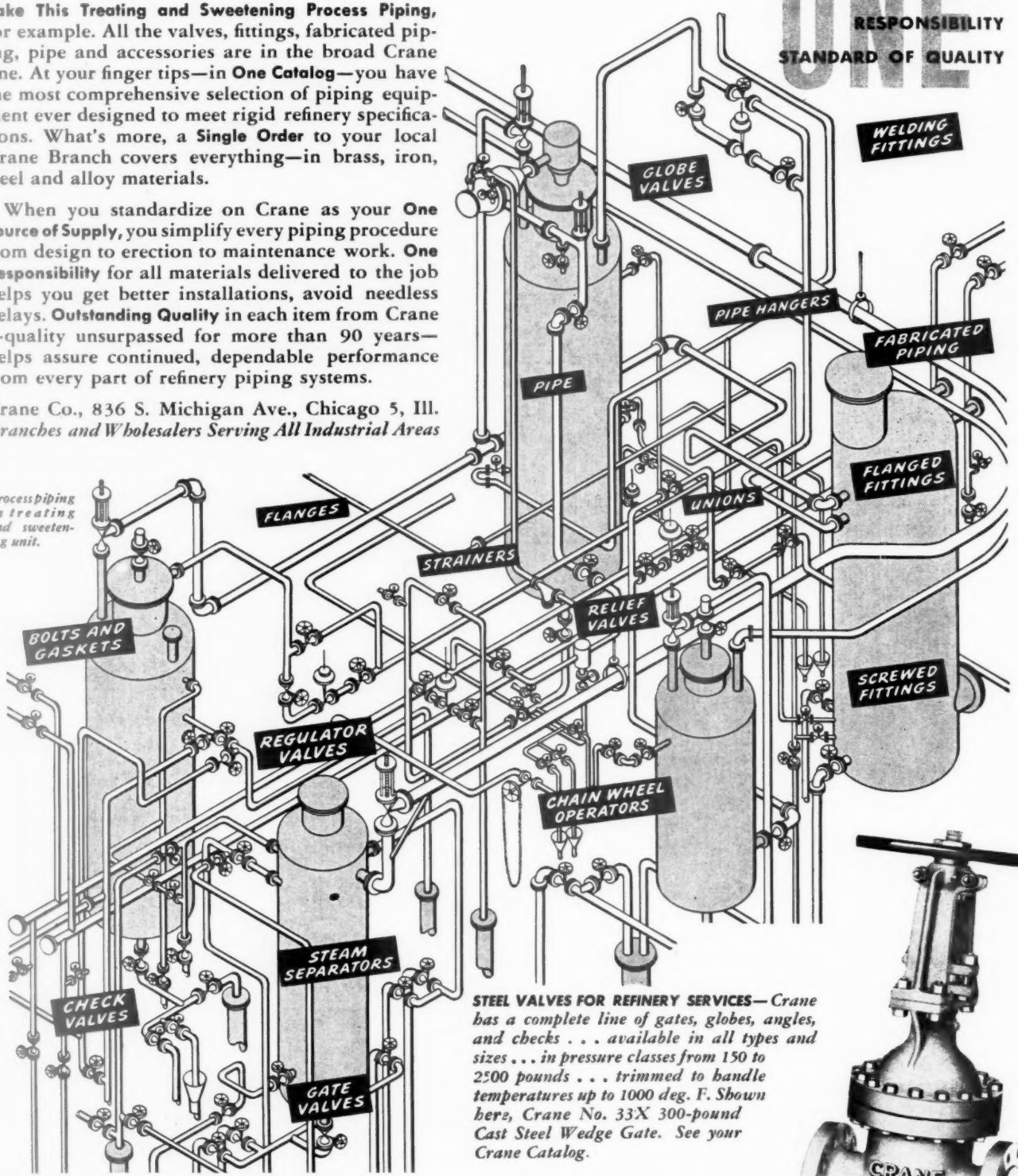

Process piping on treating and sweetening unit.

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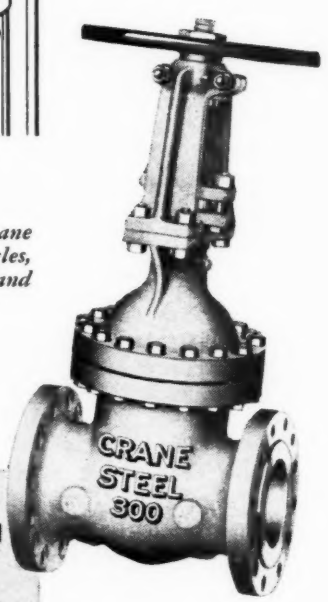

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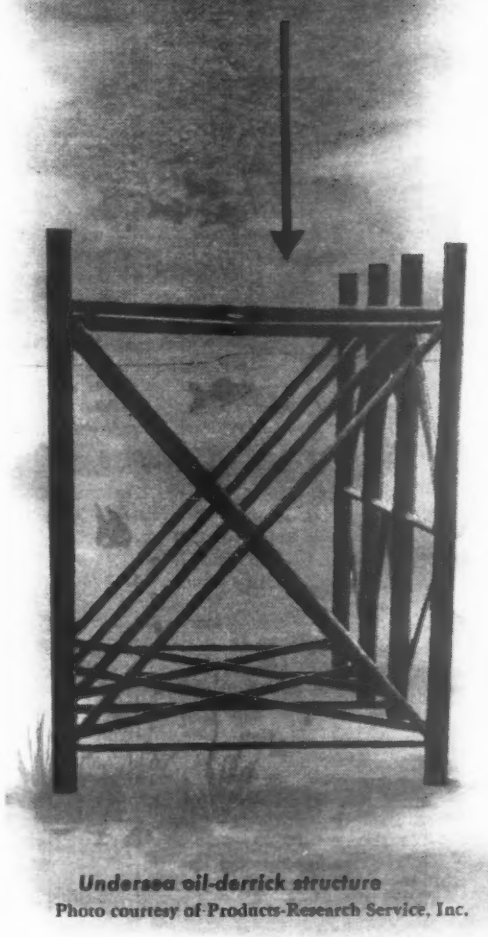

Undersea oil-derrick structure
Photo courtesy of Products-Research Service, Inc.

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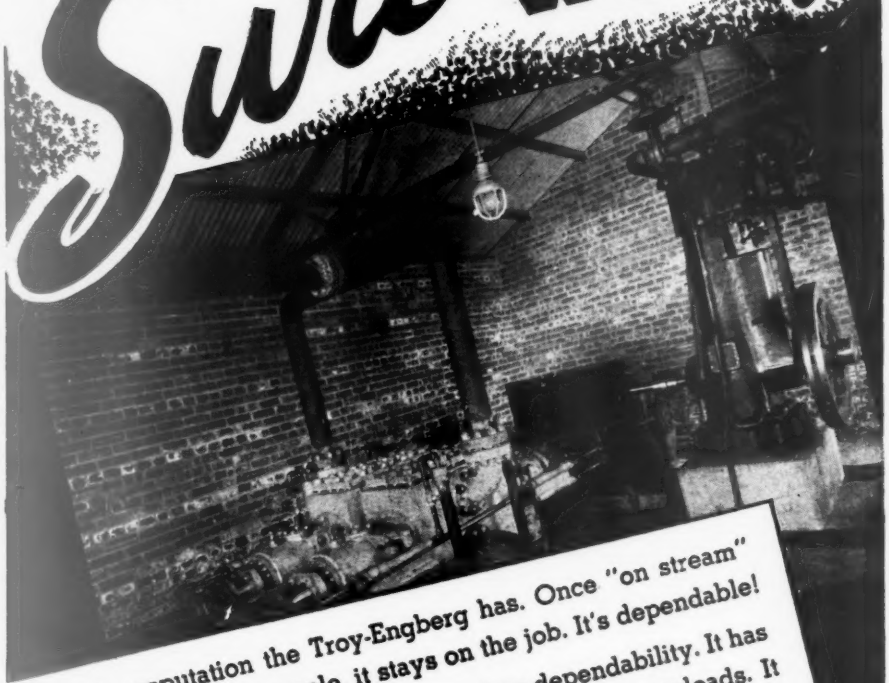

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MEETINGS

Dec. 2-3—Petroleum Electric Power Assn, Biltmore Hotel, Oklahoma City, Okla.

Dec. 3—National Gasoline Assn of America, regional meeting, Amarillo, Texas.

Dec. 4—Nomads Christmas Party, Louis Sherry's, 50th St. and Park Ave., New York.

Dec. 9-11—Interstate Oil Compact Com, annual meeting, Allis Hotel, Wichita, Kan.

Jan. 10-14—SAE, annual meeting, Book-Cadillac Hotel, Detroit, Michigan.

Jan. 12—Institute of Petroleum, monthly meeting, Manson House, 26, Portland London, W. 1.

Feb. 9—Institute of Petroleum, Manson House, 26, Portland Place, London, W. 1.

Feb. 28-Mar. 4—ASTM, spring meeting, Hotel Edgewater Beach, Chicago, Illinois.

Mar. 6-10—American Institute of Chemical Engineers, Los Angeles, California.

Mar. 7-10—NACE, annual meeting, Cincinnati, Ohio.

Mar. 9—Institute of Petroleum, Manson House, 26, Portland, London, W. 1.

Mar. 9-10-11—API, Southwestern District meeting, Galvez Hotel, Galveston, Texas.

Mar. 17-18—Oklahoma Utilities Assn, Hotel Tulsa, Tulsa, Oklahoma.

Mar. 23-25—API, Mid-Continent District meeting, Mayo Hotel, Tulsa, Oklahoma.

Mar. 27-April 1—ACS, spring meeting, San Francisco, California.

Mar. 28-30—SAE, Transportation meeting, Statler Hotel, Cleveland, Ohio.

Mar. 28-30—Western Petroleum Refiners Assn, annual meeting, Plaza Hotel, San Antonio, Texas.

Apr. 11-13—American Society of Lubrication Engineers, annual meeting, Pennsylvania Hotel, New York.

Apr. 11-13—Mid-West Gas Association, 44th annual convention, Hotel Ford, Des Moines, Iowa.

Apr. 11-13—National Assn of Corrosion Engineers, Netherlands Plaza Hotel, Cincinnati, Ohio.

Apr. 11-15—Western Metal Congress and Exposition, Shrine Auditorium, Los Angeles, California.

Apr. 12-14—Southwestern Gas Measurement Short Course, O. U., Norman, Okla.

Apr. 12-14—National Petroleum Assn., Hotel Cleveland, Cleveland, Ohio.

Apr. 13—Institute of Petroleum, Manson House, 26, Portland, London, W. 1.

Apr. 13-14-15—National Petroleum Association, Hotel Cleveland, Cleveland, Ohio.

Apr. 18-20—Mid-West Power Conference, Hotel Sherman, Chicago, Illinois.

Apr. 20-22—Natural Gas Assn, annual meeting, Texas Hotel, Fort Worth, Texas.

Apr. 27-28-29—API, Eastern District meeting, William Penn Hotel, Pittsburgh, Pa.

May 2-4—ASME, spring meeting, New London, Connecticut.

May 2-4—Independent Petroleum Assn of America, mid-year directors' meeting, New Orleans, Louisiana.

May 8-10—American Institute of Chemical Engineers, Tulsa, Oklahoma.

May 11—Institute of Petroleum, Manson House, 26, Portland, London, W. 1.

May 9-10—American Gas Association, spring meeting, French Lick Springs Hotel, French Lick, Indiana.

May 12-13—API, Pacific Coast District meeting, Biltmore Hotel, Los Angeles, Calif.

May 26-27—API, Rocky Mountain District meeting, Gladstone Hotel, Casper, Wyo.

May 26-27—The Natural Gas and Petroleum Assn of Canada, annual meeting, Hotel London, London, Ontario.

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The Lander anticline, oldest producing field in Wyoming. *Standard Oil Company (New Jersey) Photo.*

Wyoming – Its Past and Its Promise

By ERNESTINE ADAMS, *Managing Editor*

WYOMING has been called the last pioneering front for the oil industry. A visit to the state lends substance and color to the statement. Virtually every major company in the industry has set up a working staff in the area for the purpose of probing with modern methods and machinery for the oil in domes folded between deep basins and high craggy mountains.

Actually Wyoming is simply the latest pioneering area of the oil industry. It presents boldly the fact that technical know-how based on scientific advances is the key to greater resources. The oil industry can gain access to Wyoming fields now because of airplanes that need no roads and big bulldozers that can build roads quickly if they are needed. It can seek deep subsurface information because of new geophysical equipment, and because of giant modern rigs it can test deeply buried structures and exploit their richly saturated rocks. The once scorned black oils can now be used because of brand new processing methods that use everything but the odor and leave surprisingly little of that. With large modern pipe line networks it can send Wyoming products to ready markets without waiting for markets next door to grow up.

EXCLUSIVE

Wyoming oil development as it is

today could not have taken place much sooner regardless of demand. Its petroleum resources stood beyond the grasp of searching hands until they held the tools for the job.

▸ **Locale.** From the air Wyoming looks like a vast relief map that a young geologist, delighting in his new knowledge of structures, might have molded with blue-gray clay. There are areas that might be a glimpse of the moon through a telescope. The mountains rise in overpowering grandeur, twists and turns of rivers are deep and sharp, the basins are wide stretches of desolation with here and there a spot of green that is a town or a bit of irrigation that emphasizes the vastness of the state.

On land, you find the quarter of a million citizens have reduced nature to comprehension if not to size. Names of oil fields are evidence of the human touch. There are Poison Spider, Big Muddy, Lost Soldier, Big Medicine Bow, Crooks Gap, Teapot, Sunshine, Steamboat Butte, Polecat, Fourbear, Torchlight, Mush Creek, Gooseberry, Tip Top. Then comes a rash of alliteration: Badger Basin, Dallas Dome, Derby Dome, Bison Basin, Little Buffalo Basin.

On land, the blue clay becomes blue sage and rough grass that fattens white face Herefords and herds of antelope and deer. Hidden streams tumble down steep mountains and clear lakes of rare beauty snuggle at the foot of their snow-topped protectors.

The aspect of geological revelation does not disappear on land, however. You can stand on the rim of a small basin and have the feeling of being at the edge of a contour map, the structure falling below in diminishing circles of sandstone and limestone outcrops. Or you can gaze across the basin and see revealed the handiwork of the powerful forces of erosion or the rough cut structure of other ages.

▸ **Geology.** Because of its obvious geological structures it is said that companies often send geologists to Wyoming for first assignments because here their maps become reality, and they slide into their new careers with greater ease. This apparent obviousness of the state's geology has to some extent limited oil development in the past. Surface geology was plain and domal drilling obvious. Some of the old timers call them "Sheepherders' Fields," because even a sheepherder could determine where to drill. The search for hidden structures has been retarded by the wealth of those in full view. But some of the cross-sections of the basins look like the more vicious dips in a roller coaster, with 200-ft elevation differences recorded between offset wells. It is becoming more apparent as geophysical and seismograph crews cover the state that buried anticlines and stratigraphic structures are also full of hidden treasure, some of which are among the deepest in the world.

It has been the advance of geophysics that has increased the potentialities of Wyoming. The state has attracted one of the largest forces of geophysical crews with 55 operations working in July. Only Texas and Oklahoma had more groups. For about three months — January, February, and March—geophysical work is cut to some extent by the cold but 40 crews were working last February. At one time exploratory work was suspended during the winter. At present, seismograph outfits are pushing the exploration of Powder River Basin, another poetic name, in the northeast part of the state and oil men say Newcastle is in the throes of an old-fashioned boom where leasehounds are so numerous they sell to each other.

▸ **History.** It was oil seeps rather than structure, however, that gave Wyoming its first oil operations. No less a distinguished writer than Washington Irving makes the first mention of Wyoming oil in his book about Captain Benjamin Bonneville. The explorer reported seeing an oil seep in 1833 to which trappers directed him at what is now called the Dallas Dome in Fremont County. On their way to Great Salt Lake in 1847 the Mormons discovered a seep in Uinta County, which they named the Brigham Young Oil Spring. They skimmed oil here for many years to use for lubricants and medicine.

It was said that Cy Iba, later famous for the Salt Creek "Iba Eighty," in company with Kit Carson, Cimineau Le Jeunesse, and Jim Bridger discovered an oil seep in the Seminoe Mountain country in 1851. They collected oil on Poison Spider creek, mixed it with flour and sold it to immigrants for axle grease.

Oil springs were reported elsewhere in what is now Lincoln County and at Sage Creek, Fremont County about the time the White and Carter springs were found. Judge Carter tried to drill a well near the spring named for him but abandoned the attempt. The oil was first used by the Indians in the country, later by immigrants and still later sold to tanners, to the Union Pacific Railroad, and to coal companies.

The earliest well was probably that drilled at Dallas Dome in 1883 by Mike Murphy, who had charge of operations there. Three wells were completed at Popo Agie, all of them producing oil. Wells were drilling about the same time in the Shannon pool at the north end of Salt Creek.

One of the first companies was Continental Oil and Transportation Company, formed in 1875 by a group of Wyoming and Utah business men. In its early days in Wyoming its function was marketing the "coal oil," which it refined at Florence, Colorado. Although the present day company, Continental Oil, is now nation-wide in its activities it is still one of the leading operators in Wyoming.

▸ **Casper.** To get a picture of the modern version of an oil boom, you must first take a look at Casper, which, with about 34,000 population, rivals Cheyenne, the capital, and has the advantage of being situated closer to the center of the state. In the 1940 census Casper had only a population of under 18,000.

In September, 1948, Casper showed the greatest gain in retail sales of any city in the United States, an indication of the force exerted by the oil boom. Another arrow in the same direction is the delay in telephone calls here and in other parts of the state. Telephone service has not caught up with the demand and two or three hours delay on long distance is not unusual.

Most of the major oil companies and scores of smaller ones have offices in the town and a number have Rocky Mountain division headquarters here.

Employment and wages in Wyoming oil and gas industry.

Comparison of number of firms and employment for June, 1942, with June, 1948, and wages for the second quarter of 1942 with the second quarter of 1948.

Industry	Firms			Employment			Wages		
	June 1942	June 1948	Per cent increase	June 1942	June 1948	Per cent increase	2nd qtr. 1942	2nd qtr. 1948	Per cent increase
Production	134	184	37	2,410	5,422	125	$1,101,500	$5,235,369	375
Refining	22	2	0	1,880	2,967	58	976,408	2,771,672	184
Transportation									
Pipelines	4	5	25	387	533	38	198,253	520,170	162
Trucking	12	35	192	189	343	81	34,787	218,274	527
Geophysical	5	48	860	60	1,231	1952	10,427	810,355	7672
Supply house	11	29	163	131	284	117	46,555	242,560	421
Total of oil industry	188	323	72	5,057	10,780	113	2,367,930	9,798,400	314
State totals for all industries covered by Employment Security Law	4498	6222		42,384	56,301		13,155,871	35,384,748	

—From Employment Security Commission.

Office space is at a premium and quarters are often cramped. When it moved in last October, Seaboard took over a bowling alley in the Producers and Refiners Building to get space and is better off than most. Phillips Petroleum quarters were makeshift until the Rocky Mountain Division office was moved from Denver, Colorado, to the Kistler Building, Casper.

The Ohio Oil Company, one of the earliest on the scene, arriving in Casper in 1913, has a substantial building of its own and is constructing a new four-story building. Stanolind Oil and Gas Company, another large Wyoming operator, has purchased the old Ohio building and will move in after Ohio occupies its new home. The others so far are depending upon local landlords and these are not-wholly-enthusiastic citizens of the old oil boom days. Casper residents can observe the boom and leave it alone. This is to be expected in the face of the past, which has turned up other surges of oil activity that receded with drying markets.

Casper housing projects are springing up in mushroom growth with 215 houses built in the first eight months of this year. Despite this prodigious construction, housing is still far behind needs and many find living conditions difficult.

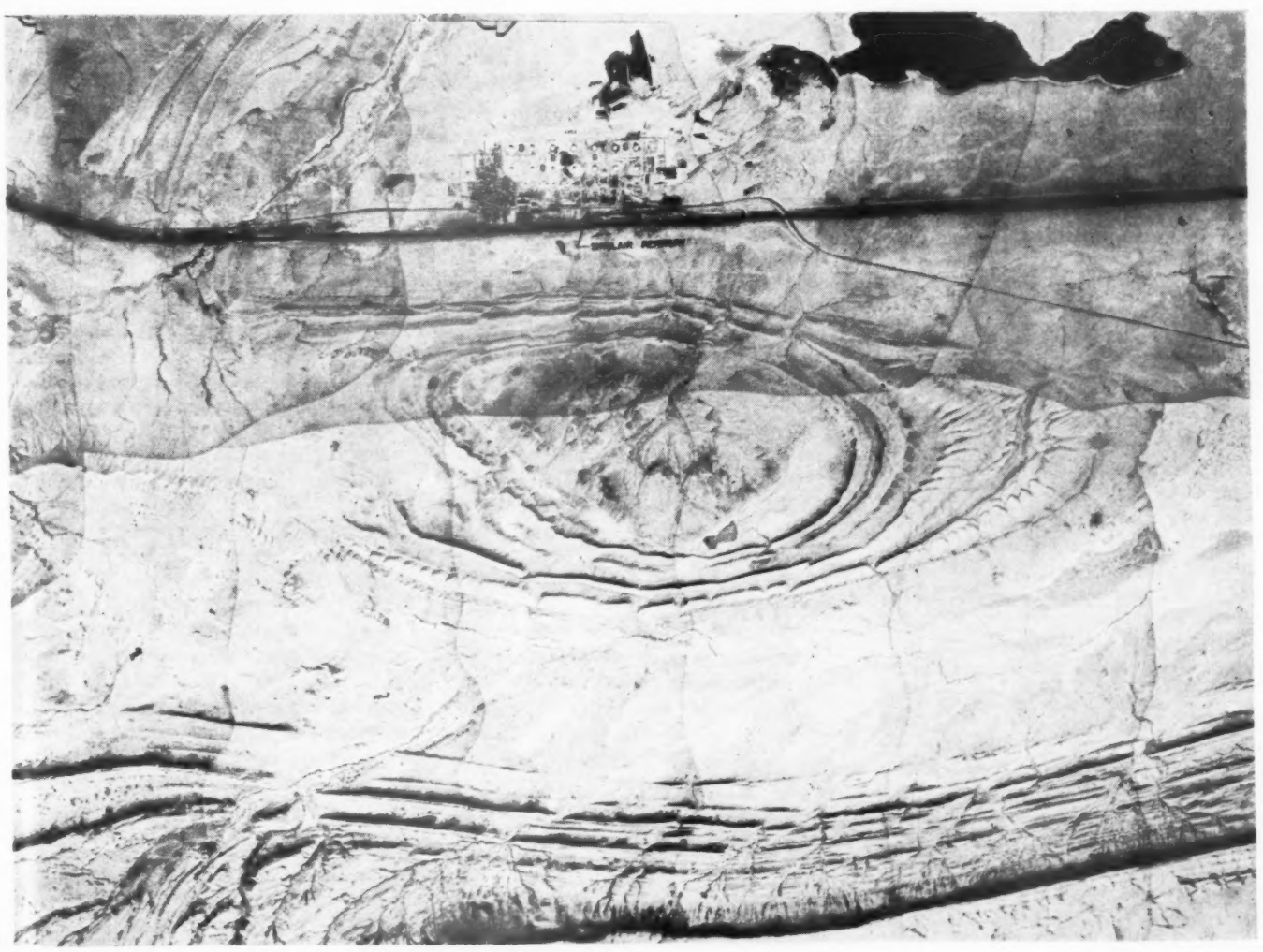
▸ **Scouting.** There is excitement, of course, in what K. S. Albert,[1] Casper geologist and engineer, calls the largest collection of oil scouts anywhere. An organization of scouts meets weekly at one of the hotels where the results of the week's investigation are shared and each man receives an assignment for the following week. The association was the natural result of the huge area to be covered, 97,914 square miles, as much as New York and Pennsylvania combined. Adjoining states are also covered from Casper. There is evidence that individual companies are dropping out recently, perhaps for the same reason some newspaper men decry press association—you can't get a scoop without competition.

[1]K. S. Albert was one-time U. S. Commissioner of Public Lands for Wyoming.

There is frequent comment that most of the Wyoming oil activity is provided by independent lease men and big oil operators. This observation is based on the fact that original leases are cheap so anybody can hold them but drilling operations are expensive and take large capital. There is considerable truth to this statement. At the same time there are many small drilling and producing operators in the state whose activities are woven into the intricate pattern that forms the modern oil industry, and they are on the whole deriving as much profit, or more, from their investments than are the larger organizations.

▸ **Ownership.** It is true that the majority of original leases are low in cost. The federal government owns at least 51 per cent of the land in the state; the state governmet owns a large share outright and mineral rights to considerable acreage where the surface rights are individually owned. The next largest landowner is the Union Pacific, which with Central Pacific completed the first transconti-

A composite picture of aerial photographs showing the Greenville Dam structure in the center, a good example of the Sheepherders' Fields of Wyoming. Near the top center is the Sinclair refinery, largest in the state.



nental railroad.[2] A Federal grant gave Union Pacific several hundred thousand acres incident to the railroad's construction. A substantial portion of the total acreage is still owned in fee and minerals were reserved in sales of the remainder.

In the Wind River Basin oil exploration, the Shoshone and Arapahoe Indians are getting a taste of the oil money that made some Oklahoma Indians rich. Oil was discovered on the Wind River reservation, central Wyoming in 1909; intensive exploration and development has taken place since 1940 and now several companies are paying the Indians good dividends.

Individual landowners are therefore in a minority. Early pioneers crossed the state on the famous Oregon and Overland Trails but few stopped. The homesteaders went on to Utah and farther West; they were not seeking oil.

Farming and industry that might have brought private ownership of the land have not been attracted to this state of austere mountain ranges and 14 inches average annual rainfall. It has been left to cattle and sheep ranchmen who found it more practical to lease grazing land as they needed it for a few cents an acre than to take on the responsibility of ownership.

It was not until late in the 19th century and the first few years in the 20th century that an oil search of any extent was conducted in the state. Soon speculators began filing on potential oil lands and operators asked the government to withdraw these lands from agricultural filing so they could carry on their exploration unhampered.

For several years at the turn of the century there was a see-saw of withdrawals and restorations of these public lands, an effort being made to withhold areas with promising geologic structures and to restore other lands to filing lists.

Leasing. Difficulty may be experienced in determining ownership of land you may want to lease. With a small population, few fences, and a predominate public ownership, you rarely find an owner available on the land to sign a lease.

Chances are that the federal government is the owner of part of the land you want and to apply for a lease you must go to one of three land offices in the state, which are at Cheyenne, Buffalo and Evanston. Of the state's oil production last year 58 per cent came from lands owned by the federal government. Oil and gas royalties[3] paid Wyoming by the federal government for the year ending June 30 totaled $3,350,000, the largest received by any state.

Federal leases were liberalized to some extent by the act of August 8, 1946, which assures a 12½ per cent royalty on new leases and discoveries and increased amount of holdings allowed to one lessee from 7680 to 15,360 acres with up to 100,000 acres for prospecting options.[4] The Department of Interior conducts lease sales by sealed bids for land upon known geologic structures. An advantage of federal leases covering a whole structure is the opportunity of obtaining unitization authorization without getting permission of multiple ownership.

Proved oil reserves in Wyoming.

1948	679,311,000 bbl
1947	589,358,000 bbl
1946	600,731,000 bbl
1945	581,730,000 bbl
1944	499,394,000 bbl

In 1947 only Louisiana and Texas increased more than Wyoming in estimated proved reserves.

When Wyoming came into the union as a state in 1890, sections 16 and 36 of each township were retained for public schools and several other plots of land running into hundreds of thousands of acres were set aside for the state. These lands are under the jurisdiction of the state land board comprising five elective offices—governor, state auditor, secretary of state, superintendent of public instruction, and treasurer.

Under the first mineral law of the state (1903)[5] its lands had to be sold but this was changed by the leasing act of 1907. The leasing act has been changed and amended and revised since its passage. State lease terms require a $11 filing fee, a $10 cash bond, and an annual rental of 25 cents per acre. Drilling operations must begin within 2 years unless extension is granted. Royalty is 12½ per cent (as in federal leases) for the 10-year term of the lease and can be fixed by the Board after that. No provision is made for withdrawal or return of fees.

On the other hand, applications for federal leases can be withdrawn and the fees returned to the applicant. For these lands the filing fee is $2 for each 160 acres and with the application is paid one-half the first year's rental, or 25 cents an acre. The Bureau of Land Management plans to change this so that a lease can be issued immediately for filing fees and 50 cents an acre rental for the first year. Rental for second and third years will be free; for next two years, 25 cents an acre each year. This would mean cash on the barrel head, no refunds, no mind changing.

At the present time about 73,000 acres of Union Pacific property in Wyoming are covered by oil and gas leases, licenses, unit and operating agreements. The practice of issuing leases has been virtually discontinued by Union Pacific. Instead the lands are usually included with other acreage under some type of unit plan in which the railroad company retains an operating interest.

Individual owners of mineral rights on their land are the same in Wyoming as everywhere only there are fewer of them than in other states that have comparable leasing activities. The most famous was the late Cy Iba, whose 80 acres in Salt Creek has produced more than 10,000,000 bbl of oil.

Drilling. It may not be too hard to lease land with oil prospects in a state where structures are showing in every corner and every one of the 23 counties has some activity, but difficulties of drilling provide a few of the hazards of West Texas and Alaska combined. Add these special Wyoming problems to the expected hardships that arise in almost all wildcat or new development operations, and you have a major operation at almost every drilling rig. This is especially significant when you realize that in July of this year almost one-third of the drilling operations in progress were wildcats.

It is small wonder that, contrary to the national trend, in Wyoming most of the new fields have been discovered by large companies. They have the money necessary to carry on operations that have run in excess of a million dollars for a single wildcat, counting exploration, leasing, etc. A sum of $15,000 to $20,000 for drilling mud in some deep wells gives an idea of cost. There are also many inexpensive exploratory wells, but it is the

Total footage all wells drilled in Wyoming.

1948	1,915,000 ft
1947	1,287,800 ft
1946	791,639 ft
1945	987,473 ft
1944	961,559 ft

[2]This wasn't the only important event in Wyoming in 1869. The same year woman's suffrage law passed giving women in the territory of Wyoming the right of suffrage, first in the United States. Some Wyoming citizens later demonstrated their belief in equal rights by hanging Cattle Kate, a woman suspected of cattle rustling, which seems to be a unique case. Mrs. Nellie Taylor Ross was the first woman governor of a state, to include another "first"; she was elected governor in Wyoming in 1924.

[3]Somewhat in lieu of taxes. Federal government gives state 90 per cent of all royalties received by government from oil on federal land; 52½ per cent is reserved and used in constructing reclamation projects by government within states where oil is produced, 37½ per cent is paid state directly, which uses it for school, institutional, and road purposes, and 10 per cent is used for administration. The $3,350,000 is 37½ per cent of total.

[4]Bureau of Land Management Circulars 1623 and 1624 set out the regulations.

[5]Memoirs of Bryant B. Brooks, governor of Wyoming, 1905-1911.

Huge trucks and heavy modern machinery have influenced the boom in Wyoming drilling. Without them exploration would be handicapped.

deeper structures that are getting the big play now and these come high. Also development drilling in old fields often means seeking production at greater depths. Several operators, who were asked to compare costs with average Mid-Continent drilling, guessed that Wyoming drilling costs were about twice as much. They insisted this was a guess. Times have changed since the well-founded tale of the company that brought in a well producing low grade oil. Having no use for the production at the time, the company ordered it shut in. Years passed and for some reason the lease was not renewed. Later a private individual leased the land and found an oil field already proved.

▸ **Roads.** The first problem of the exploration driller is roads. Because of its sparse population and relatively few towns, in conjunction with the fact that so small a part of the land is taxable by the state, there are few main highways (all blacktopped or paved however) and not many all-weather dirt roads. Chances are that a long road over rough land must be built to the location.

One manager of a large company told of an instance where it was decided that building a road to a location was uneconomical and supplies were carried over a rocky trail. Loss of time and truck maintenance cost more in the end than the outlay estimated for the road.

Because modern heavy machinery is needed right at the beginning of the drilling operations, suitable access roads are a prime requisite. Modern road machinery is therefore a saving factor. It is doubtful if some locations could be made without heavy earth and rock moving machinery.

Even after they are built the maintenance of roads to operations is costly. Winter months find caterpillars with snow plows working their way over the blanketed trail. On mountain highways you see straight posts about 6 ft high at the side of the paved roads. They are the only guides or markers for snow plows when the highway is covered.

Another Wyoming hazard is the herds of antelope and other livestock that roam the vast unfenced lands and may wander onto the roads when the driver thinks there is no one within 50 miles. A small surprised and surprising antelope has given many a driver a hard jolt.

▸ **Air travel.** A DC-3 swept down through cloudless skies and landed at Casper airport. It was assumed by onlookers that the 21-passenger plane was on regular airline service. It wasn't until a group of oil men and oil equipment were unloaded that they learned it was a Kerr-McGee plane for company use. Most of the oil operators and contractors have private planes.

Good air service is provided by regular lines and by several charter companies. W. M. Saxon, division manager of Pure Oil, has his headquarters in Billings, Montana, but manages to commute to Casper by regular lines without inconvenience.

▸ **Water.** Generally water is the object of the first drilling on a location and the cost is high. There is rarely any water on the surface, and a great deal is needed for deep tests. Also, lack of salt in subterranean waters in this region results in water and oil sands giving the same reaction on electrical surveys. This necessitates more than the usual number of drillstem tests.

Wyoming well completions.

1948	440
1947	270
1946	170
1945	225
1944	205

▸ **Supply.** Virtually every location is hours from supplies and services. The largest trucks available move in machinery and derricks. A good proportion of the drilling rigs are large, including the huge National 160 with a 189-ft derrick that Superior is using at Pacific Creek in Sublette county. Heavier machinery and greater quantities of equipment are needed than for Mid-Continent operations. When some small item holds up operations on an outfit of this kind, and it does happen, the expense rolls up.

Casper has the largest concentration of supply houses in the state and stores are established at other points but it would be impossible to put in enough stores throughout the state to supply quickly all the far-flung operations.

▸ **Weather.** It is a local saying that Wyoming has two seasons, July and winter, which is a native exaggeration but the winter season is long and it is cold, going as far as 40 degrees below zero. There has been a decided change for the better, veteran operators point out, and most work can be continued all year except in extreme altitudes and in isolated spots. Mean average daytime temperature in January is 24 degrees.

The altitude is high with the lowest point being about 3100 ft above sea level, (Belle Fourche River Basin) and the highest 13,785 ft, which is Gannett Peak, Fremont county. The K.P.M. well in the Wyoming anticline, Sec. 36-25½-115, Lincoln County, has a 8800-ft elevation. Highest elevation at surface in present operations is the wildcat in the Jackson Hole area being drilled by Stanolind and Sinclair. It is some 8600 ft above sea level. April snow has been 5 ft deep on the level at this location. Some 4000 to 7000 ft elevation is probably average and the high dry cold is not unpleasant for human beings. The warming Chinook winds often hold off the worst freezes. One operator maintains that the worst time of the year is spring when thaws suck away the firm foundations winter has formed.

Low temperatures, however, give drilling operations a great deal of trouble. Occasionally, a rig is forced to shut down altogether as was the custom in earlier days; certainly there is no inclination to begin an operation in deep winter. Steam boilers and electric heaters may not hold off the

paralysis of frozen mud or water lines. Crews have been snowed in and relief crews unable to get to location despite the work of the rotary snow plow, another piece of equipment that is needed for Wyoming operations.

Not only does cold and snow hamper operations but strong winds sweep across the basins with such force that derricks can be toppled. More and stronger guy lines are used effectively for the most part. An extremely high wind is sometimes hard to withstand, however, regardless of precautions.

Formations. In most areas are found hard formations similar to those in West Texas although there is some fracturing that presents circulation problems. Drilling requires more time both because of the difficulty of penetration and of the possibility of getting a crooked hole if too much weight is used for the steeply dipping formations. Some operators estimate that it requires from three to four times as long as the same depth well would take in average Mid-Continent fields. The record in the Mush Creek area of 2500 ft in 24 hours with one bit is an exception and there are others, but operators agree that there are few such fast drilling jobs to bring down the average. The average drilling time is stretched further when the amount of deeper drilling in old fields and the trend in deep wildcats are considered.

Most of the drilling in the state is done by contractors. Ohio Oil, largest producer in the state, has three drilling rigs but this is unusual. Wyoming drilling conditions call for specialists and in this state the contractors have proved their right to the title.

Because of the hard formations. diamond coring is becoming more widely used.

The hard formations have their good points also. The most important concerns the twin facts that there is little trouble with sand and heaving shales, and that a minimum amount of casing is needed. In Elk Basin, wells have produced from 900 ft of open hole in the Madison lime. In these days of steel shortage it is an advantage that great quantities of casing are unnecessary to a project.

Production. Wyoming oil production is more distinguished for its recent increases than for its contribution to the nation's output. Its importance lies largely in potentialities, and the unparalleled demand of today is bringing its possibilities into sharper focus. Without the high prices resulting from heavy consumption, the new fields of Wyoming could well have remained untouched for another generation.

Former Interior Secretary Ickes has suggested that Wyoming fields be shut in for government emergency use. Actually the shutting-in of fields or the restriction of production to demand has happened already. It will require another 10 years of activity like the present to arrive at any sound estimate of the state's real crude oil reserves. So far the estimates are interesting chiefly for their range despite the amount of exploration accomplished.

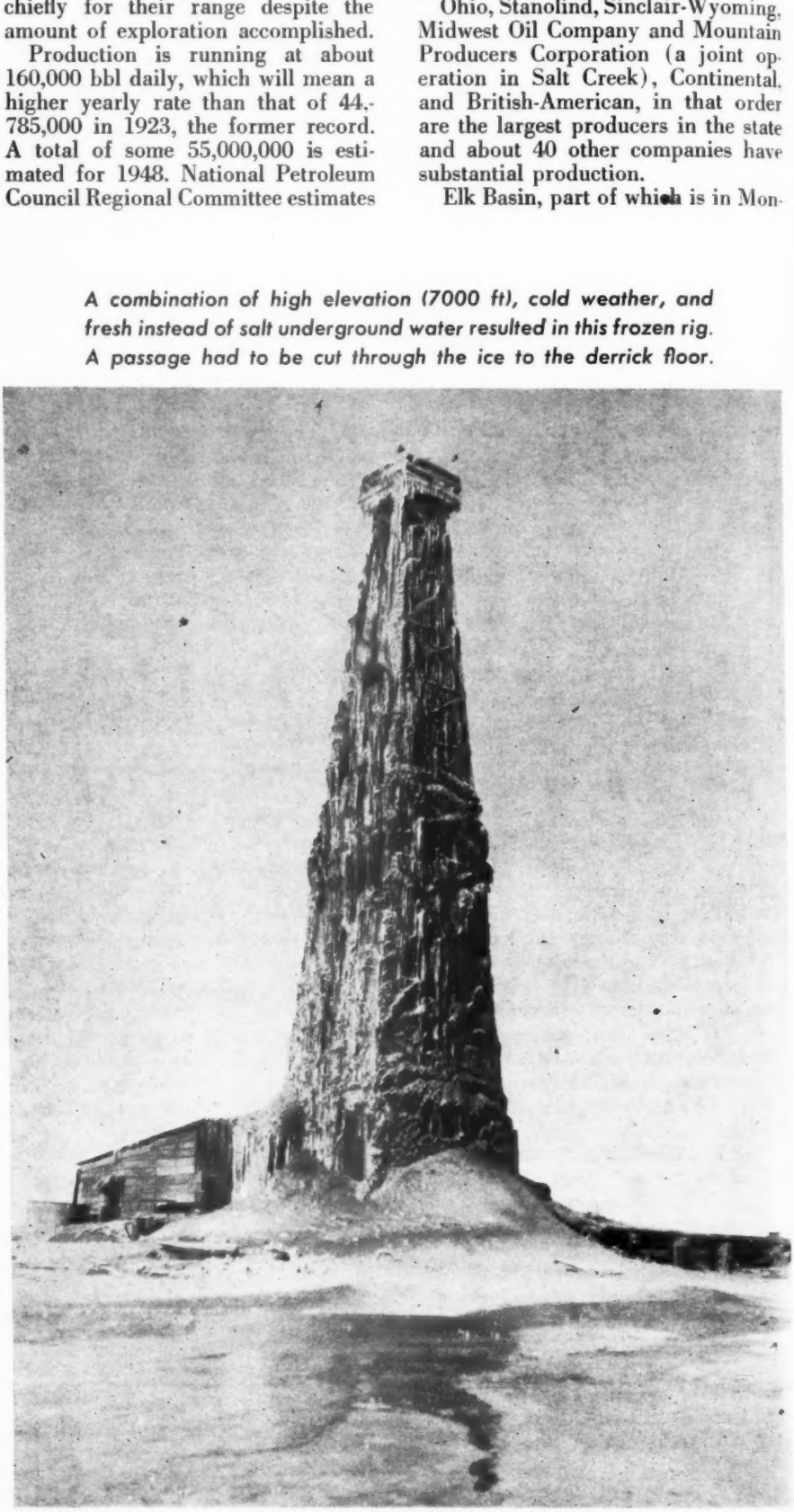
Production is running at about 160,000 bbl daily, which will mean a higher yearly rate than that of 44,785,000 in 1923, the former record. A total of some 55,000,000 is estimated for 1948. National Petroleum Council Regional Committee estimates production will reach 190,000 bbl daily the last quarter of this year.

The state levies a production tax on oil and gas based on value of the production for the calendar year to which is applied the regular tax levy of the school district in which the oil and gas is produced.

Ohio, Stanolind, Sinclair-Wyoming, Midwest Oil Company and Mountain Producers Corporation (a joint operation in Salt Creek), Continental, and British-American, in that order are the largest producers in the state and about 40 other companies have substantial production.

Elk Basin, part of which is in Mon-

A combination of high elevation (7000 ft), cold weather, and fresh instead of salt underground water resulted in this frozen rig. A passage had to be cut through the ice to the derrick floor.



tana, where Stanolind has been the unit operator since June, 1946, has recently surpassed famed Salt Creek as the heaviest producing field in both these states. Its output in 1947 was some 6,000,000 bbl, the largest part of which was heavy oil of 27 to 32° API.

Salt Creek, north of Casper, has the largest cumulative production, which has reached close to 333,000,000 bbl to date since its discovery in 1909.

It was Salt Creek that gave geologists such a false impression of reserves in Teapot Dome, joining the area on the south. So far development —or lack of it—has resulted in continual downward estimates of reserves. According to estimates of proved reserves the Teapot is going dry. The Naval Reserve lease that shook the Harding Administration to its boots is not producing now and no effort has been made to find its potential reserve since 1927 when most of its 86 wells were shut in.

Even in Wyoming every field is not a prima donna but it is hard to find one that hasn't some lines on the industry stage outside the chorus of production. There's Neiber Dome, Washakie county, that had stubbornly resisted long years of wildcat probing until January when the California Company went to 10,025 ft to find production estimated at 850 bbl in the Embar. The highest hydrogen sulphide content—42 per cent—showed up, too, and the new plastic lining was used in the tubing to fight corrosion.

There's General Petroleum's Cole Creek production, which is the only field in the state that is trying water pressure maintenance.

In South Cole Creek field Phillips in September brought in new production from 8333 ft. Other companies had drilled here before but hadn't gone deep enough. As late as 1942 a well went to 7214 ft before being plugged and abandoned.

Seaboard's Silver Tip takes the stage for a turn that spotlights the kind of prize that brings on the fever for more and more wildcats. The first well, completed in March, flowed black oil from the Embar at about 8500 ft at the rate of 450 bbl a day. A drillstem test had shown oil in the Frontier at 6000 and before March was over a second hole brought in a 100-bbl well of 47° sweet oil. In September the Tensleep showed up with oil at 8664-750 ft. The Silver Tip is apparently on a gold standard.

Two of the new fields yet unproved are among the world's deepest. If deep drilling problems and costs can be whipped into line, they promise also to be highly profitable. One is the Mountain Fuel Supply Company's field at Church Buttes where well No. 5 is now drilling. This is a gas and condensate field that has strong economic possibilities because of good market prospects on the West Coast. Production is from the Dakota at about 12,500-13,000 ft and initial output has been in excess of 45,000,000 cu ft of gas per well daily with considerable condensate. A 4-month production trial will begin when gas from the field is turned into the main pipe line to Salt Lake City this winter for the first time.

Wyoming Annual Crude Oil Production

Year	1000 bbl.	Year	1000 bbl.
1910	115	1930	17,868
1911	187	1931	14,834
1912	1,572	1932	13,418
1913	2,407	1933	11,227
1914	3,560	1934	12,556
1915	4,246	1935	13,755
1916	6,234	1936	14,582
1917	8,978	1937	19,166
1918	12,596	1938	19,022
1919	13,172	1939	21,454
1920	16,831	1940	25,711
1921	19,333	1941	29,878
1922	26,715	1942	32,812
1923	44,785	1943	34,253
1924	39,498	1944	33,356
1925	29,173	1945	36,219
1926	25,776	1946	38,977
1927	21,307	1947	44,238
1928	21,461	1948	*55,000
1929	19,314		

*Estimated.

The second deep field has the world's deepest oil production. It is the West Poison Spider well of Pure Oil Company. A second well is drilling. The discovery had an estimated 800 bbl a day production from 14,309 ft in a Frontier formation sand.

One of the most interesting fields in the world is the Lost Soldier field of Sinclair-Wyoming. Discovered in 1916, at a depth of 265 ft in Wall Creek sand, development has never ceased. Fifteen sands in the field have had oil and some have now been exhausted. Small in area, it is said to be among the most prolific fields in the U. S. In June, 1948, a Cambrian sand well was completed after drilling to a total depth of 6288 ft in the Pre-Cambrian granite for an initial production of 720 bbl in 24 hr. This is the only Cambrian production in the Rocky Mountain region and is rare the world over. Some oil men have remarked that even granite will produce at Lost Soldier and an engineer at the field admitted there was stain in granite that was drilled.

It might be good medicine to contemplate how Lost Soldier would have fared under Mr. Ickes' proposal to rope off Wyoming fields for emergencies.

The State of Wyoming is not a member of Interstate Oil Compact although Pierre La Fleiche, State Mineral Supervisor, attends the meetings as an observer. There is no proration of production in the state. Production is nevertheless limited by economic factors, by transportation facilities, and by that Old Man of the Northwest, Cold Weather, which sits on the back of operations from Fall to Spring.

There are about three pumpers to one flowing well in the state and there are a preponderance of electrical installations. Some new fields must be pumped from the beginning. Most of these fields have two or more producing formations but dual completion of wells is not generally practiced.

There is more gravity drainage than in average Mid-Continent fields because of the high structural relief in Wyoming fields. Water-drive fields can be operated very efficiently due to the steeply dipping structures.

Some geologists say that producing formations in the region are unusually thick, citing the productive Tensleep sand, which is normally 200 to 350 ft thick. Others, however, point out that with steep formation dips, the drill cuts through the sand at an angle so that penetration is not always a true measurement of actual thickness. The thick formations require larger amounts of nitroglycerin for shooting, taking as much as 1200 or 1500 quarts where shooting is required.

Installations of such equipment as control valves and treaters are protected from the cold by insulation. Gathering lines are buried about 6 ft below the surface in most fields to be under the frost line.

The problem of completing a new well in the winter season is obvious. When the well is already on the pump there are times when it is impossible, for the pumper to get to the location and no production is obtained.

Water in Wyoming oil fields not being salty freezes quickly and with winter this freezing brings a slowdown along the entire route from the producing well to the refinery and the greater the distance, the more time for the cold to make itself felt. The comparatively fresh water, on the other hand, averts the salt water disposal problem of other regions.

Transportation from some fields is a very real limitation on production. It is not unusual for crude oil from a Wyoming field to be sent by truck, by railroad tank car, and finally by pipe line to a refinery. Pipe line networks are being built up but they are inadequate so far. From Silver Tip, for instance, the Ohio Oil Company pipe

line picks up Seaboard's crude oil and delivers it into the Stanolind pipe line 7 miles away. It goes to Frannie, Wyoming, where it is loaded into tank cars on the Burlington route to the Texaco refinery at Casper.

There's Continental, which not long ago opened a new sweet oil field in the Sussex area in the Powder River Basin where cattlemen and sheepmen once battled in what was called the "Rustler War." The wildcat flowed 1000 bbl a day from the Lakota sand at 7726 ft. The company is taking only 240 bbl a day, trucking it to the Stanolind pipe line.

In the rich Worland field Pure Oil has had to limit production to the amount that can be moved out by rail.

Crude from the Mush Creek area—a stratigraphic-type pool, by the way—is piped or trucked to Newcastle to two small refineries, the Carter and Gray.

There is enough trading for pipe line facilities to keep a corps of CPA's busy. Limitations of production because of transportation might also be compared to West Texas where gas and sour crudes went begging until demand and new techniques brought them into use.

There is the potential of a lively and enlightening study of economic features of Wyoming production. How far the oil industry itself has advanced in economic conservation could be readily appraised in this state outside the Interstate Oil Compact. The big landowner, the U. S. Government, can limit production from its Federal leases but in these times of high demand there is little interference. California also is not a member of the Interstate Oil Compact but it has an older history and operations were worked out with respect to a greater consumption in the immediate locale before pressure maintenance projects were well developed.

Unitization of fields has a strong hold in Wyoming with the process of unitizing simplified in some cases by single ownership. Pressure maintenance plants already in operation are being enlarged and new ones are planned for most of the fields that have developed enough to assure practical returns. Scheduled by General Petroleum is a $2,000,000 gas recovery and repressuring plant at Sand Creek field. The nitrogen injection plant of Stanolind at Elk Basin is the most ambitious project of this kind ever attempted.

Sinclair Wyoming has had a gas-injection plant in operation in its Wertz field since 1941. This has allowed greatly increased production while still increasing the reservoir pressure and has been a very successful operation.

Wyoming oil industry as a per cent of state totals.

	1942 per cent	1948 per cent
Firms	4	5
Employment	12	19
Wages	18	28

—From Employment Security Commission.

One of the strong influences in conservation is the high price of natural gas. There is a ready local market and a constant pull for supply from the West Coast which only awaits pipe lines for a high demand. Six cents is not an unusual price for gas and there are reports of contracts for twice that amount.

This effort to obtain the greatest economic value of fields augurs well for the state and is a strong indication of the advanced planning by operators who do not expect to make a field pay out in a day but work on long term, scientific methods that may take longer than a lifetime but yield the greatest possible net returns.

▶ **Refining.** A sample of Wyoming oil in 1890 was sent by Pennsylvania Oil and Gas Company to Pittsburgh for analysis. Chemists who examined the crude oil said it was not a natural mineral for there was none like it in the world and it must be compounded of animal oils.

So were the heavy oils of Wyoming introduced to a small but properly amazed world. At first this strange crude was considered as useful in its natural state as other oils were after they had been refined. It sold for as much as $10 a barrel.

In 1895 the Pennsylvania Company began making lubricating oils at Casper in the first and, for many years, the only refinery in the state. The lube sold for $14 a bbl.

Market for these refined products was limited. The expensive oils were no competition for coal as a fuel and uses were restricted to lighting, lubrication, and medicine.

In time the high sulphur and asphaltic oils came to be considered inferior and certainly they caused corrosion problems from well to refinery with no compensating advantages in the processed output because of low gasoline content.

It became common practice to shut-in a black oil field, opening up to produce enough for a specific order, but always at minimum prices. The "lost" oil well mentioned before produced this black oil and the story demonstrates the low regard in which it was held.

Even the asphalts from Wyoming crudes were for years believed to be inferior to those of other areas until the Bureau of Mines, after long, tedious experiment proved that they were, in fact, better than most.

To the Bureau of Mines goes also much credit for its research on the properties of black oils to prepare for the recent evolution in processing, which opened the market to black oils. It has been only in the last five or six years that black oils found a ready market, due principally to the development of catalytic cracking. Now George W. Jarvis, a veteran Wyoming independent operator, says he thinks black oil is better than green but he would be the first to admit that his opinion has changed.

Those operators of 1890, who thought their black oil better than any, could say "This is where we came in."

Casper remains the processing center for Wyoming, as it was when the state had only one refinery. Three large plants are situated on the North Platte River, which bounds the north side of the city. Of these, two are in process of enlarging and the third has only recently completed its expansion.

The Texas Company increased crude capacity of its plant from 7000 to 12,000 bbl daily by adding a fluid catalytic cracking unit, a gas recovery unit, and other equipment.

A general expansion and improvement program is under way at the Socony-Vacuum refinery that will double the present daily 3000-bbl throughput. A Thermofor catalytic cracking unit is being built and also a unit to remove hydrogen sulphide from 4,000,000 cu ft daily of refinery gas. Products are gasoline, kerosine, distillate, heating oils, tractor and diesel fuels, and asphalt.

The plant of Standard Oil Company (Ind.) with a 13,000 bbl capacity is being enlarged and reconstructed so that more black oils can be processed. Additions include fluid catalytic cracking, vapor-recovery, and new distillation units. Eventually Standard's Greybull refinery in Big Horn county will be consolidated with the Casper facilities.

The Standard and Socony-Vacuum plants are both scheduled for completion this year.

Outside of Casper are some 30 other processing plants. The Sinclair Refining Company has the largest capacity of any catalytic cracking unit in the state with a run of 20,000 bbl a day. This plant, at Sinclair, Carbon county, was expanded during the war. Continental Oil Company's Lance Creek gasoline plant, manufacturing gasoline, butane, and propane, is the largest of its type in Wyoming.

Frontier Refining Company, Cheyenne, expanded in 1947 to handle a throughput of 10,000 bbl a day. A thermal cracking unit was added,

Crane setting 56-ft deethanizer tower as part of installations at Elk Basin gasoline plant, Parks County. Plant will be operated by Stanolind.

which uses heavy charge stock and gives a high gasoline yield.

The 6500-bbl refinery of Ohio Oil Company at Lovell in Park county produces road oil, fuel oil, and asphalt.

▸ **Menace into profits.** One of the finest stories in the oil industry is the development of turning hydrogen sulphide gas into sulphur. Recent processing magic makes a fairy godmother look not only practical but commonplace.

Hydrogen sulphide, H_2S, has been a constant menace in some of the Wyoming black oil fields, a danger to human beings, a blight on equipment. There is the chilling true story of the man who went into the cellar on a repair job and did not come back. After a time another followed to see why he had not completed his work, and at last a third man went in. All three were victims of the fatal gas that has the same effect as the deadly hydrogen cyanide gas that is used for lethal chambers in several states.

Now that operators are more familiar with the gas there are few accidents. Light concentrations of H_2S are easily noticeable because of the odor but the odor is difficult to detect in strong concentrations because it paralyzes sensory nerves. The instant a crew member gets a sniff and loses consciousness he is pulled into fresh air and given first aid in the form of artificial respiration.

One well brought in by Pure proved so potentially dangerous that it was fired with an incendiary bullet to burn the poisonous gas. The well, in the Worland Dome field producing from Embar lime, got out of control when a wellhead fitting failed and released some 10,000,000 cu ft of gas containing 30 per cent H_2S to the air. Gas was ignited as a safety measure. Later the well was brought under control and is presently producing.

Not only is H_2S dangerous to human beings but it kills all vegetation and is highly corrosive. It destroys casing, pipe lines, and other equipment and has been known to cause tanks to explode. This last was the result of H_2S coming in contact with iron in the tank battery and forming iron sulphide, which upon combining with oxygen from the air, can ignite spontaneously. Various materials and methods have been tried out and some were found to be deterrents, if not cures, for the shriveling touch of hydrogen sulphide—plastic linings for pipes, scrubbers to keep tubing wet when it is brought out of a well so it won't catch fire, use of formaldehyde in drilling, galvanized tanks, and nitrogen instead of air to fill tanks.

Not satisfied with mere protection against H_2S the industry developed a process for manufacturing powdered sulphur from the dry gas. The Gulf Coast has some of these plants that transform the dangerous gas into the yellow powder normally mined from the earth in its natural state. Today one plant is building and another is planned in Wyoming.

Stanolind expects to have its Elk Basin plant operating next spring. This will process the H_2S from the casinghead gas produced with the heavy oil, manufacturing 70 long tons of free sulphur a day from 12,000,000 cu ft of gas in addition to usual products. Dry gas from the plant will be burned with air to make an inert gas mixture to be injected back into the reservoir.

Pure Oil Company and Texas Gulf Sulphur Company have plans for a larger sulphur recovery plant in Pure's new field at Worland where 30,000,000 cu ft of gas a day will be processed. Sweet gas and liquids will be returned to Pure after the H_2S is withdrawn and converted into sulphur.

▸ **Bureau of Mines.** The Laramie station of the Bureau of Mines has been and is an integral part of oil development in Wyoming. It has smoothed the way of progress with its comprehensive study of petroleum and natural gas fields in the state, its comparison analyses of asphalts, its continuing survey of crudes, and its development of accurate and uniform analytical methods. It has worked with private companies on special projects and has published a substantial number of reports on regional research.

In the early days of oil activity in Wyoming, the Bureau was the government agent for federal leases. Salt Creek field was under its control until 1925 when the duties were transferred to the U. S. Geological Survey.

The imposing new headquarters at Laramie, finished in 1947, has spacious offices and the best equipped laboratory in the Rocky Mountain region. Under H. P. Rue, supervising engineer, John S. Ball heads refinery studies, Ralph H. Espach, production research, and H. M. Thorne, the oil shale program that began in 1944. These men direct a hundred engineers, technicians, and other employes in searching for improved methods and new information that will aid the cause of conservation.

▸ **U.S.G.S.** Two branches of U. S. Geological Survey work with the oil industry in Wyoming. The Geologic Branch office at Laramie is under the direction of J. D. Love and is con-

cerned with field and laboratory studies of oil-bearing rocks and regional geologic mapping. During the last five years the Geologic Branch has published or completed geologic maps of approximately 18,000 square miles in and around the basins that contain oil and gas in Wyoming.

The Conservation Branch office at Casper, Wyoming, is in the charge of J. R. Schwabrow, who supervises oil and gas operations in the Northwestern region covering 11 states from headquarters at Casper. His staff in 8 district offices approve drilling and production activities on federal and Indian lands in the region, keep account of oil and gas production, and process unit agreements involving said lands. Wyoming's extensive unit agreements are listed on Pages 50 and 51.

▸ **Wyoming Geological Survey.** The Geological Survey of Wyoming is a state agency charged with making studies of the geology and mineral resources of Wyoming. The Survey, under the direction of Dr. H. D. Thomas, is situated at the University of Wyoming at Laramie. As a result of field research, numerous papers of value in petroleum exploration have been published on regional geology, geological structure, and stratigraphy.

In addition to the research program, the State Geological Survey maintains an oil well sample and core repository. This is the largest collection of Wyoming oil well samples in the region and samples from important Rocky Mountain wildcats and from representative field wells are available to the public for study.

▸ **Resources Research.** In connection with the University of Wyoming is the Natural Resources Research Institute, headed by H. G. Fisk. The organization, established by the state legislature in 1943, is set up to aid the development of Wyoming through laboratory investigations such as studies of bentonite, coal, and sugar beets. As yet there has been no attempt by the Institute to evaluate petroleum resources.

▸ **Education.** The University of Wyoming, the state's only University, has long contributed graduates to the petroleum industry of Wyoming and of the nation. The College of Engineering, headed by Dean H. T. Person, has trained civil, electrical, and mechanical engineers who hold responsible positions on the staffs of oil companies operating in Wyoming and the Rocky Mountain region. For some years the college offered a special curriculum in engineering designed especially to qualify graduate engineers for employment in the petroleum industry. For the last six years, the college has offered a general engineering course leading to the B.S. degree with a petroleum engineering option. In addition to courses in civil and mechanical engineering, the program includes courses in geology, chemistry and other related subjects. At present 42 men are registered in the course and steps are being taken by Dean Person to strengthen the program through the addition of specific petroleum engineering courses.

The department of geology, headed by Dr. S. H. Knight, has for years, specialized in the training of petroleum geologists. Graduates of the department are employed not only in Wyoming but in all the nation's petroleum provinces. Many have attained prominence as geologists, geophysicists and executives. Students majoring in the department number 205 and come not only from Wyoming but from over the nation and from South America.

Wyoming Map

See map on page 188 for locations of Wyoming fields, plants, and pipe lines.

The new Casper Junior College, established three years ago, has shown its willingness to cooperate with oil companies in education and training. There have been special classes offered for students and employes in such studies as blue print reading, drafting, drilling mud control, and refinery instrumentation. An advisory committee composed of men in various branches of the industry works with M. F. Griffith, dean of the college, to design the educational offerings that will have the greatest value. Plans are to schedule one and two-year programs for students who want to become drillers, oil field engine maintenance workers, and geophysical workers.

▸ **Bentonite.** Wyoming not only produces oil but also provides material to drill for it. The state supplies more than one-third the national output of bentonite, a highly colloidal clay used in drilling to prevent drilling muds from settling and solidifying. The first discovery of bentonite was reported in Wyoming and the state is credited with the first shipment in 1888. At that time it was worth $25 a ton. Found principally in the Black Hill and Big Horn areas, bentonite has become increasingly important with the gradual substitution of rotary for cable-tool drilling and the trend toward deeper drilling. In the Wyoming booms of 1916-17 and 1922, cable tools were used almost exclusively, today they are used rarely.

▸ **Oil shale.** The largest, although not the richest, oil shale beds in the U. S. are in Wyoming and they may some day be a heavy producer of shale oil. H. M. Thorne, Laramie, is in charge of the Bureau of Mines research on the subject. He points out that his big problem comes under processing instead of production. There is such diverse opinion on oil shale reserves that estimates of the state's potential reserves are relatively meaningless. Experiments now in progress use Colorado shales that yield a higher percentage of oil.

▸ **Publications.** News of Wyoming operations is well covered by local and regional publications besides the general magazines of the industry. The three Goodin brothers have "Petroleum Information," a reporting service, with offices at Casper and Denver. Henry Hough, who publishes the *Oil Reporter* at Denver, stresses Wyoming activities as the largest producing state in the Rocky Mountain region.

Newspapers in Wyoming give a fair amount of oil coverage, the most comprehensive being that of the Casper Tribune-Herald. Irving Garbutt, the Tribune oil reporter, is in the center of activities at Casper.

▸ **Wyoming motion picture.** The Bureau of Mines film library will soon have a brand new motion picture of the natural resources of Wyoming. Sponsored by Sinclair Refining Company, the color film presents a story of the state, its agricultural and mineral wealth, and scenic splendor. The film is available on loan to organizations without cost from the U. S. Bureau of Mines.

▸ **Conclusion.** So this is Wyoming, a land of promise whose wildcatters start higher to drill deeper, whose black oils had to wait for the new catalytic cracking, and whose invisible poison is transformed into useful yellow powder.

This is the land where the oil industry has converged to seek caches of petroleum in contrasting scenes of hushed grandeur and of desolate wastes, a task that is possible and useful only because of recent developments in methods and tools of the industry.

Many operational problems common to other oil areas must be dealt with in the state and in addition some individual puzzles of its own are presented. In spite of conditions, or maybe because of them, the industry has pulled out all stops in its cheerfully determined assault on the earth-locked reservoirs of Wyoming and early results as well as growing Northwest markets proclaim a continued activity. ★ ★ ★

Wyoming Oil and Gas Regulations

By W. HUME EVERETT*

THE first official recognition of Wyoming as potential oil producing land came before it was a state, when in 1878 John W. Hoyt, Territorial Governor, reported: "at the railroad crossing of Bear River in Uintah County along the railroad near Green River station . . . in the valley of the Popo Agie . . . and doubtless at many other points in Wyoming there are indications of very large deposits of crude petroleum and kindred carbonaceous substances. At (Bear River) crossing borings have been made with a view to practical operations. Oil bearing shales lie upon the surface . . . and at a depth of 175 feet the underlying sand rock was struck with an increase of oil."[1] Governor Hoyt then succinctly stated what was for years afterwards to be said in varying ways and tones of dispair by his successors and others: "the present price of petroleum, coupled with the cost of transportation, does not afford a very powerful stimulus to this enterprise, but there is no doubt of the value of the deposit." By 1881 Hoyt was able to say that a company had been formed by an Omaha group to collect, store, and transport Wyoming oil.[2] The word collect was used advisedly, as evidenced by this extract from a report of Professor Samuel Aughey, geologist of the University of Nebraska, who informed the Omaha people: "on Saturday, October 16, 1880, I started to investigate the oil basin of the territory (of Wyoming) . . . I reached the Shoshone oil basin on the 19th and commenced my investigation of the petroleum springs . . . Within these three acres, . . . wherever a depression is made into the gravel, petroleum arises and accumulates." It may have been this phenomenon which gave rise to the fable among oil men that at some points in the state one could stamp in an oil well with the heel of his cowboy boot.

The 1890's saw the beginning of what was to be the great landmark of oil development in Wyoming—the Salt Creek Field. The history of this field in itself is a fascinating study of men grappling with an economic giant whose strength none of them fully appreciated. Suffice it that in the 1890's and early 1900's the evolution of Salt Creek eclipsed for a time all oil development in the state and in the nation. The first serious discoveries in the field occurred during the years 1905 through 1910. Land records of the day are studded with such exotic names as the Petroleum Maatschappij, Salt Creek and Societe Belgo-Americane Des Petrols du Wyoming. The federal government had not entirely forgotten the reports of its territorial governors and their successors, for in 1909 all government land in the field was withdrawn from entry, part of which later opened, and again in 1918 lands in the notorious Teapot Dome (adjoining Salt Creek) were set aside for the use of the United States Navy as Petroleum Reserve No. 3. Between 1912 and 1920 vast areas of public land throughout the state were removed from entry under the placer mining laws of the United States. On February 25, 1920 the Oil Lands Leasing Act became operative having a profound effect upon conservation legislation, as approximately 65 per cent of Wyoming is subject to lease and operations under it as amended. By 1917 the ingredients of the Wyoming oil picture had all been introduced. The great producing areas such as Salt Creek, Grass Creek, and Elk Basin were discovered and developed in varying degree; rail transportation had supplanted horse drawn tank wagon trains, refineries and pipe lines (to a lesser degree than now) operated to supply the ever increasing demand for oils and products (the automobile, with its internal combustion engine brought a consequent new use for gasoline and lighter oils) in what was to become the greatest oil consuming nation in the world.

There was suspended, however, a sword over the infant oil industry of Wyoming—the inescapable economic fact that all the oil anyone could want was in Wyoming, but no one wanted it. Great fields lay fallow. Test wells were drilled and plugged. Producers took the oil from nature's storage placing it in artificial storage of their own to await a market. The local demand of the Rocky Mountain region required no considerable amount of petroleum products in comparison to the rich outflow of the Rocky Mountain fields. The oil of the Rockies could not compete with the Mid-Continent, Eastern, and California oil in vying for the market of the populous areas. Employment was reduced in the production and processing of petroleum; the whole economy of producing and refining centers was threatened; bankruptcies were common among those who had not trimmed their sails to the reduction in production and marketing of Rocky Mountain oil products. In 1933 the most productive horizons of Rangely—that great field just across Wyoming's southern border—were discovered and the initial well shut in; there was no market for the oil. Crude sold for as little as ten cents a barrel. The outlook was not bright. It was during these desperate days that the oil states of the Mid-Continent area fostered and created the Interstate Compact to Conserve Oil and Gas and much of the conservation legislation which was to become an integral part of the oil scene. It was in 1933 that a well drafted oil conservation law, designed to place Wyoming in line of march with the conservation parade, was defeated in the Wyoming Legislature. Thus we note then the same divergence apparent today between Wyoming and oil producing states in the matters of

This article is the condensation of one chapter in "Conservation of Oil and Gas, a Legal History, 1948." The volume is prepared by the Committee on Special Publications of the American Bar Association and is edited by Blakely M. Murphy. Each chapter covers regulations for the conservation of oil and gas in one particular state and is written by an attorney thoroughly grounded in that state's laws as they pertain to oil and gas operations. The book will be put on sale December 10.

*Division Attorney, The Ohio Oil Company, Casper, Wyoming. Ernest Wilkerson, Casper attorney, is listed as associate editor in the volume from which this article is taken and Pierre La Fleiche, State Mineral Supervisor, Casper, is listed as advisor.

[1]Ann. Rep. Terr. Gov. Wyo. to Sec. of Int. (1868).

[2]Ann. Rep. Terr. Gov. Wyo. to Sec. of Int. (1881).

The Author

A native of Colorado, William Hume Everett received his LLB at the University of Denver School of Law in 1931. He was with the Supreme Court of Texas in 1933, and associated with a San Antonio law firm from 1933 to 1939, later going into private practice there. In 1941, Everett was made division attorney for the Casper, Wyoming, division of The Ohio Oil Company, and has continued in that capacity. He was a former director and officer of the San Antonio Bar Association, and is now on the Wyoming highway commission.

conservation law and of participation in the Interstate Oil Compact. With the advent of the second World War came an increased demand for crude oil and its products and a concomitant increase in drilling, producing, refining, and leasing activity.

Conservation legislation. Any discussion of oil and gas conservation law in Wyoming is met at the outset with a question as to the authority of the Board of Land Commissioners, other state officials or bodies, over the various diverse land divisions within the state. Some of those land divisions are:

1. State lands and mineral rights granted to Wyoming by the United States, including lieu lands.

2. Public lands of the United States including those in which a Federal agency, department, or corporation has reserved or acquired mineral interests.

3. Indian lands within as well as outside the ceded portion of Indian reservations. Generally such lands are subject to lease by the tribal council with the approval of the Commissioner of Indian Affairs and of the Secretary of the Interior.

4. Railroad lands—those falling within the limits of railway land grants.

5. Oil placer mining claims. Some of these are still operated under placer mining law, under claims initiated prior to February 25, 1920; others have been taken to patent under the placer mining laws of the United States and under valid claims surrendered to the United States for preferential permits under the Oil Lands Leasing Act of February 25, 1920.

6. Carey Act lands. Title to these lands was generally granted to the state to be held in trust for settlers, who upon compliance with statutory requirements, became entitled to an unrestricted patent from the state.

7. Fee lands. Apparent problems in leasing lands within these divisions are magnified in considering the necessity and advisability of a conservation statute, its administration and enforcement—particularly in answering the query as to whether the state in its police power has or can legislate any right over public lands and mineral interests (or the development and production of oil or gas therefrom) of the United States and its agencies and corporations. Without debating that issue, it may be said that such regulatory legislation as the Wyoming Legislature has enacted has been upheld by the Supreme Court of the United States.

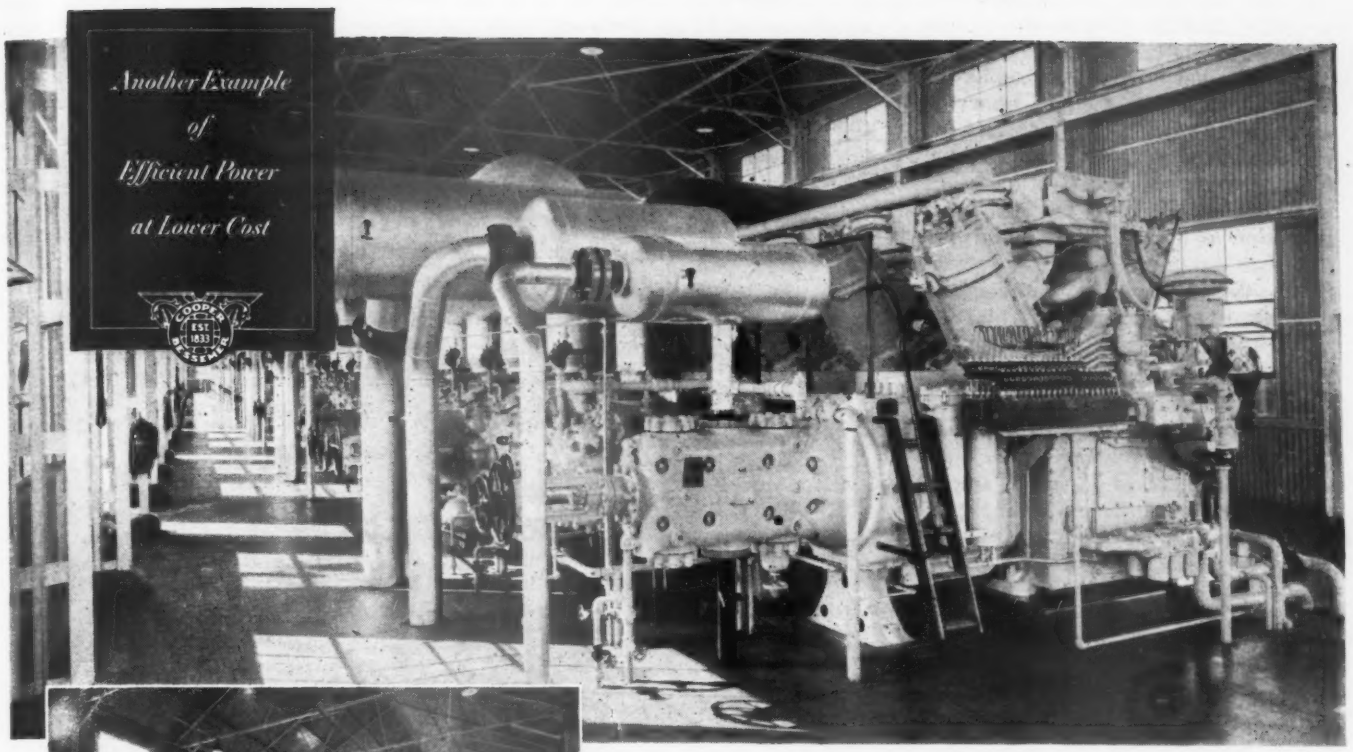
The Wyoming Constitution of 1889 created a Board of Land Commissioners composed of the Governor, the Secretary of State, the State Treasurer, the State Auditor and the Superintendent of Public Instruction, giving it the direction, control, leasing, disposal, and care of state lands for the support and benefit of public schools. The police power of the state is declared supreme over all corporations as well as individuals. The Governor, by and with the consent of the State Senate, appoints a Commissioner of Public Lands, whose duties include keeping records and the seal of the Board. He is also secretary of the agency. The law allows the Commissioner to appoint a deputy and a State Mineral Supervisor to assist in the performance of his mutiple duties.

The first legislation classified as a basis for administration and conservation of oil in Wyoming was enacted in 1901. However, so far as is known, nothing in the nature of a conservation regulation or order has issued from that measure. Provision was made therein for the appointment by the Governor of a State Geologist "... charged with the duty of enforcing all laws of the State of Wyoming relating to the oil industry ..." "The Professor of Geology and head of the Department of Geology of the University of Wyoming shall be eligible" for this appointment and received no salary in addition to that from the University.[3] The first and only statute in Wyoming which specifically defines waste was enacted in 1919 and is unchanged. Under this carbon black Act the use, consumption, or burning of natural gas without the heat contained fully and actually utilized for manufacturing or domestic purposes is wasteful and unlawful when the well or source of supply is within 10 miles of an incorporated town or industrial plant. No person having the possession or control of any natural gas well whether a contractor, owner, lessee, agent, or manager, is permitted to use, sell, or otherwise dispose of natural gas from it for the purpose of making carbon or resultant products from burning or consumption of gas without its heat being fully and actually utilized. The penalty for violation upon conviction is a fine of not less than $100 or more than $1000 for each offense; each day of violation is a separate offense. The constitutionality of this act was upheld in the Supreme Court of the United States in the case of *Walls v. Midland Carbon Company*, decided December 13, 1920, and there have been no other cases where the statute's terms have been questioned.

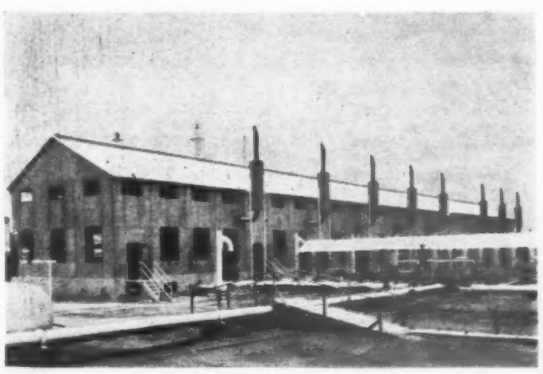
In 1921 the principal conservation statute, under which the industry now operates, was enacted. Without expressly repealing the duty of the state geologist, the legislature in 1933 transferred his responsibilities under the 1921 Act to the Commissioner of Public Lands. That statute, again amended in 1933, provides that the Commissioner, for conserving the natural resources of Wyoming, and to prevent waste through negligent methods of operations, prescribe and enforce rules and regulations governing the drilling, casing, and abandonment of oil and gas wells and the waste of oil and gas upon all lands in the state, except those public lands subject to the Act of February 25, 1920. The enactment states that the rules and regulations adopted shall be those from time to time promulgated by the Bureau of Mines or the Secretary of the Interior of the United States under the congressional act governing methods of operations upon lands within permits or leases issued under its terms. The Act further makes it the duty of all persons drilling or operating oil and gas wells upon patented or state land to comply with the rules and regulations, to file with the Commissioner all logs of wells and other requisite reports, and to control by casing, drilling, and plugging all wells. All well logs and reports are confidential and not disclosable without the written authority of the operator, except that they may be offered in evidence if relevant in a prosecution under this law.

To enable the administrator to carry out his statutory duties and enforce

[3]Dr. H. D. Thomas is State Geologist and has performed excellent service to the state in his field. His ability is at least partially recognized by Wyo. Laws 1947, c. 114 in authorizing and directing him "to study insufficiencies or inconsistencies between presently effective statutes ... or affecting rules and regulations of other public authority, concerning operations in or with respect to all mines and mining operations (other than oil and gas deposits) in said State" and to report to the next legislature the results of such study with related recommendations for enactment of curative legislation.



• Engine side of the eight compact 1,000 hp GMV-angle compressors in Magnolia Petroleum Company's West Ranch gasoline extraction plant. Note trim, clean-cut appearance typical of GMV installations.



• Main compressor house, containing Cooper-Bessemer GMV units shown and described above and at right.

How flexible GMV's meet the needs at Magnolia's West Ranch processing plant

THIS gasoline extraction installation is typical of the effectiveness of Cooper-Bessemer GMV-angle compressors in meeting virtually any combination of processing requirements.

Here, eight 1,000 hp GMV's each driving five compressor cylinders for four-stage compression, handle up to 26 million CFD of formerly flared gas, discharging at 1050 psig into Magnolia Petroleum Company's line to Beaumont. The gas is processed at the third stage discharge, maintained at a constant 325 psig. Automatic speed control and first and fourth stage variable volume unloaders maintain desired pressures and assure fully loaded engines at all times.

This space-saving GMV installation, as usual, is highly efficient, economically operated, completely dependable. As you plan your compressor requirements for the future, look into the new things, new advantages, new savings offered by one of America's *oldest* engine and compressor builders.

The Cooper-Bessemer Corporation

MOUNT VERNON, OHIO — GROVE CITY, PENNA.

New York City Washington, D. C. Bradford, Pa. Parkersburg, W. Va.
San Francisco, Calif. Houston, Dallas, Greggton, Pampa and Odessa, Texas
Seattle, Wash. Tulsa, Okla. Shreveport, La. St. Louis, Mo. Los. Angeles, Calif.
Caracas, Venezuela Gloucester, Mass, Calmes Engineering Co., New Orleans, La.

the rules and regulations, he appoints a State Mineral Supervisor whose duties are those established by law, and such other tasks prescribed by the agency head. The Commissioner is authorized to delegate his powers for specific purposes to inspectors of the Federal Bureau of Mines or other qualified person, who receives compensation as fixed by the administrator. No appointment of a special representative is made without the consent of the well owner.

The Supreme Court of Wyoming in 1935 held that this Act, under which the Supervisor and Commissioner are charged with carrying out the duties imposed by law and enforcing the rules and regulations, makes "ample provision . . . for the ascertainment of damages to the state by reason of negligent physical operation of oil and gas wells in the state, and the right to employ outsiders for that purpose would seem to be excluded." The penalty for conviction of a violation of the statute, the rules and regulations, or the lawful orders of the commissioner, his assistants or representatives, is a fine of not more than $500 or imprisonment of not more than six months. There has never been a penalty assessed during the twenty seven years the statute has been effective.

The State Mineral Supervisor, one of the most able and competent public officials we have ever had in Wyoming, has done a magnificent job singlehandedly of preventing waste brought to his notice; he is cooperative and has steadfastly protected, without adequate assistance, the state's interest in unit agreements and in all forms of conservation practice permissible under existing laws. Administration and enforcement under the present ineffective law are wholly insufficient; no test of efficacy can be had until the legislature provides proper laws and appropriations.[4]

▸ **Unit agreements.** The United States Geological Survey, Casper, Wyoming, with the efficient cooperation of its supervisor and his staff, makes possible the formation of numerous unit agreements in the Rocky Mountain area. In Wyoming 84 unit agreements have been approved by the Department of the Interior, as of January 30, 1948, embracing approxi-

[4]La Fleiche, *Report for Wyoming*, VI INTERSTATE OIL COMPACT Q. BULL. 97 (1947) in which reference is made to the present law as follows: "Although the law goes far toward the elimination of waste it lacks much of the essence of modern conservation legislation. The inadequacy of the law is recognized by a great majority of the constructive minded operators of the State and repeated efforts have been made to secure enactment of a more comprehensive statute. No law, however adequate, lacking proper administration and enforcement facilities, may be considered effective, and the limited personnel in the conservation office of Wyoming, one Mineral Supervisor and a secretary, is a severe handicap.

***More Federal Unit Agreements** are found in Wyoming than in any other state. As of June 30, 1948, there were 163 such agreements in the United States of which 92 were in Wyoming, 4 in Alaska, 9 in California, 16 in Colorado, 2 in Louisiana, 1 in Michigan, 12 in Montana, 17 in New Mexico, and 10 in Utah. The list below, collected by the United States Department of Interior, Geological Survey, at the Casper, Wyoming, offices, shows the agreements by unit name, the date when each became effective, the operator, the acreage covered, location, and present operative status. Earlier agreements sometimes involved productive areas and provided that the unit should remain in effect so long as production was in paying quantities. Recent agreements have a definite expiration date of 5 years or less and automatically expire at the end of that term unless oil and gas has been discovered. Usually a test well must be commenced within 6 months after the agreement has become effective. The agreements may be terminated at any time if the operator does not wish to continue drilling or if some default occurs.*

Unit agreements in Wyoming in effect September 1, 1948.

Arranged alphabetically by fields.

Name of unit	Effective date	Operator	Gross acreage	Township and range	Drilling or producing status
Adon	10-13-47	Texas Company	39,430	51, 52 & 53N., 71 & 72W.	Oil dis.
Alkali Anticline	9- 1-43	Mule Creek Oil Co.	3,960	54 & 55N., 95W.	Dry
Alkali Butte	11- 1-36	Texas Company	2,759	33 & 34N., 95W.	Oil, gas S.I.
Alkali Creek	8- 1-44	Alk. Cr. & M. F. S. Co.	13,584	13 & 14N., 99 & 100W.	Dry
Badger Creek	3- 1-47	Union Oil Company	16,316	57N., 82W.	Dry
Baggs	12- 1-44	S. Marvin James	4,317	12 & 13 N., 91 & 92W.	Dry
Bailey Dome	9- 1-44	Sinclair-Wyo. Oil Co.	2,400	26N., 89W.	Oil dis.
Barren Butte	8- 1-44	Continental Oil Co.	6,153	26 & 27N., 92W.	Dry
Beaver Creek	9- 1-37	Stanolind Oil & Gas Co.	17,166	33 & 34N., 96W.	Gas dis.
Big Sand Draw (gas)	1- 1-32	Sinclair-Wyo. Oil Co.	1,960	32N., 95W.	Gas
Big Sand Draw (oil)	3- 1-44	Sinclair-Wyo. Oil Co.	1,780	32N., 95W.	Oil dis.
Big Sandy Dome	7-24-47	Ohio Oil Co.	4,964	26N., 86 & 87W.	Dry
Billy Creek	9-15-30	Montana Dak. Util. Co.	710	48N., 82W.	Gas
Bison Basin	3- 1-37	E. J. Boeseke, Jr.	1,278	27N., 95W.	Oil, S.I.
Black Mountain	4- 1-46	Texas Company	2,522	42 & 43N., 90 & 91W.	Oil
Bright	2- 4-48	Tidewater Assoc. Oil Co.	6,728	36 & 37N., 64W.	Drg.
Bud Kimball	5-27-47	Texas Company	2,757	45N., 88W.	Dry
Canyon Creek	1- 1-38	Westates Oil	14,505	12 & 13N., 100 & 101W.	Gas, S.I.
Castle Creek	6-28-46	Oil Inc.	9,200	38N., 80 & 81W.	Dry
Chalk Mountain	6-18-48	Stanolind Oil & Gas Co.	7,200	28N., 81W	Drg.
Church Buttes	9- 1-44	Mountain Fuel Supply Co.	49,838	15 to 18N., 111 to 113W.	Gas dis., S.I.
Clay Basin (part in Utah)		Mountain Fuel Supply Co	553	12N., 105W.	Gas
Cole Creek	9- 1-38	General Pet. Corp.	18,686	34 to 36N., 77W.	Oil
Corley	2-27-46	Continental Oil Co.	2,161	43 & 44N., 93W.	Oil dis.
Crooks Gap	10-21-44	Sinclair-Wyo. Oil Co.	2,235	28N., 92 & 93W.	Oil dis.
Dubois	10- 5-45	Sinclair-Wyo. Oil Co.	2,241	42N., 107W.	Oil dis., S.I.
East Antelope	5- 9-47	Continental Oil Co.	7,126	26 & 27N., 93W.	Gas dis., S.I.
East Bailey	12-21-45	Wasatch & Cameron	4,139	26N., 88 & 89W.	Dry
East Lance Creek	4- 1-38	Continental Oil Co.	7,040	36N., 64W.	Oil, gas
East Sand Draw	1- 1-45	Sand Draw Oil Co.	2,906	32N., 94 & 95W.	Dry
Elk Basin (part in Mont.)	6- 1-46	Stanolind Oil & Gas Co.	12,608	57 & 58N., 99 & 100W.	Oil
Enos Creek	12- 1-47	Ohio Oil Co.	4,238	45 & 46N., 99 & 100W.	Gas, S.I., Disc. pending
Fourbear	9-19-34	Honolulu Oil Corp.	7,301	47N., 102W. 47 & 48N., 103W.	Oil, S.I.
Garland (Ohio-Utah So.)	7-25-35	Ohio Oil Co.	3048	55 & 56N., 97W.	Oil, gas
Garland (Ohio-Kin. Coast.)	8- 1-36	Ohio Oil Co.	6,965	56N., 97 & 98W.	Oil, gas
Gebo	9- 1-43	Continental Oil Co.	3,536	44N., 95W.	Oil dis.
Golden Eagle	7- 1-46	Pioneer Oil Corp.	2,039	45N., 96 & 97W.	Oil, gas
Gooseberry	5- 1-37	General Pet. Corp.	7,437	46 & 47N., 100W.	Oil, S.I.
Granite Creek	2-17-47	Sinclair-Wyo. Oil Co.	8,800	38 & 39N., 114W.	Dry
Great Divide	10-18-46	Carter Oil Co.	20,529	26N., 92 & 93W.	Dry
Green Mountain	7-27-48	British-American Oil Prod. Co.	4,350	28N., 94W.	No drg.
Horse Center	6-23-48	Superior Oil Co.	3,718	51 & 52N., 101 & 102W.	Drg.
Horse Creek	2- 1-43	General Pet. Corp.	4,527	16 & 17N., 68 & 69W.	Oil dis
Lance Creek	1- 1-38	Cooperative	2,875	35 & 36N., 65W.	Oil, gas
Little Buffalo Basin (gas)	1- 6-31	Stanolind Oil & Gas Co.	4,806	47N., 99 & 100W. 48N., 100W.	Gas
Little Buffalo Basin (oil)	10- 1-43	Stanolind Oil & Gas Co.	17,652	47 & 48N., 99 & 100W.	Oil
Little Grass Creek	7- 1-43	Continental Oil Co.	1,240	46N., 99W.	Gas
Little Round Mountain	3- 1-47	Union Oil Company	29,198	19 to 21N., 115 & 116W.	Dry
Lysite	4- 5-46	Sinclair-Wyo. Oil Co.	7,859	39N., 90 & 91W.	Dry
Mahoney Dome	2- 1-42	Sinclair-Wyo. Oil Co.	3,357	25 & 26., 88W.	Oil
Muskrat	10- 1-34	Sinclair-Wyo. Oil Co.	15,952	33N., 91W. 33 & 34N., 92W.	Gas
Neiber	10- 1-45	California Company	14,558	45N., 92 & 93W.	Oil dis.
North Casper Creek	4- 9-48	Pure Oil Co.	8,432	36 & 37N., 81 & 82W.	Dry
Northern Hiawatha	11- 1-36	Vermillion Oil Co.	3,518	12 & 13N., 99 & 100 W.	Dry
North LaBarge	1- 1-40	Western Oil Ref. Co.	2,520	27N., 113W.	Oil
Oil Mountain	10- 1-44	Texas Company	2,264	32 & 33N., 82W.	Oil dis., S.I
Oregon Basin	3- 1-48	Ohio Oil Co.	14,234	50, 51 & 52N., 100W.	Oil & gas
Oregon Trail	2-17-44	Sinclair-Wyo. Oil Co.	15,172	27N., 100 & 101W.	Dry

Table Continued on Page 55

mately 761,000 acres of land. These agreements are entered into for the purpose of conserving natural resources and preventing waste. The secretary in most cases requires parties to the unit agreements to accept all pertinent valid regulations, including operating and unit plan directives, heretofore issued or in the future. The Board of Land Commissioners joins in unit agreements on behalf of Wyoming and is empowered to modify and change any and all terms of state leases whenever granted, including the extension of their primary term for the full time the cooperative or unit plan remains in effect, "to facilitate the efficient and economic production of oil and/or gas from the lands so affected."

Conservation Bills. Several proposals for a Wyoming conservation policy have been made but failed of passage for one reason or other. New proposals were made as recently as 1945 and 1947.

House Bill No. 150, advocated by the State Mineral Supervisor in 1945, was very comprehensive in term and sufficiently drastic to assure compliance. It was designed primarily to prevent physical rather than economic waste and (with one exception as to determination of market demand), the supervisor was vested with all its powers. A clause was contained, somewhat unusual in conservation legislation, which provided that "each and every producer of crude oil or gas in a common pool or reservoir (shall) be not denied his fair share of the available market production thereof." This was passed in the House but not in the Senate, possibly because it had not been presented to the industry for study and consideration prior to introduction. It was generally opposed by the Rocky Mountain Oil and Gas Association. Another act sponsored by the supervisor, who felt the necessity for some form of conservation legislation, was House Bill No. 102 of 1947. In effect and substance it was about the same as House Bill No. 150, which failed to pass in 1945. No affirmative legislative action was taken.

Appraisal and conclusion. In and during the period between 1921 and 1945 there was an economic oversupply of oil (particularly black oil) in Wyoming. That factor alone was sufficient in a limited way to effectuate some conservation, for the reason that many fields had to be shut in at frequent intervals because of lack of a market. The results obtained conservation-wise under unit operations have been successful, primarily in providing the necessary working arrangement for secondary recovery.

The present law, with the exception of carbon black manufacture, is wholly inadequate as a conservation measure in these respects: (1) There is no definition of either physical or economic waste, (2) there is no requirement as to: Spacing of wells, (3) cycling, recycling or repressuring, (4) water-oil and gas-oil ratios, (5) preservation of reservoir energy, (6) open flow wells, (7) ratable taking, and (8) no provision for the establishment and payment of an adequate and well qualified administrative staff.

A proper educational program must be conducted prior to the introduction of any further conservation law, both within and without the industry, because of the general apathetic attitude of the people, the legislature, and the industry in connection with any new regulatory measure. Having specified the deficiencies in the present Wyoming law, those items should be properly covered and included in a new conservation measure akin to those previously introduced. The impelling reasons for the enactment of adequate conservation legislation are:

1. Waste prevention.
2. Protection of correlative rights.
3. Spacing of wells and secondary recovery control.
4. Determination as to authority over various classes of lands.
5. The need for the creation of a state administrative office or agency with proper administrative and enforcement facilities.

* * *

Wyoming Articles

See other sections for reports of Wyoming geology, oil and gas operations, refining problems, and pipe lines.

Table Continued from Page 50

Unit agreements in Wyoming in effect September 1, 1948.

Arranged alphabetically by fields.

Name of unit	Effective date	Operator	Gross acreage	Township and range	Drilling or producing status
Pacific Creek	6- 1-48	Superior Oil Co.	36,591	27 & 28N., 102 & 103W.	Drg.
Pinedale	8-13-48	Murphy Oil Co.	93,067	29N., 107W. to 35N., 109W.	No drg.
Pitchfork	1- 1-32	Honolulu Oil Corp.	2,564	48N., 102W.	Oil
Ramshorn Anticline	7-27-48	Sinclair-Wyo. Oil Co.	7,252	43 & 44N., 114 & 115W.	No drg.
Red Hills	4-23-48	Carter Oil Co.	5,920	42 & 43N., 113 & 114W.	Drg.
Red Springs	1- 1-37	J. W. Bales	1,520	43N., 93W.	Oil
Rocky Point	9-12-47	Pure Oil Co.	2,722	56 & 57N., 69W.	Dry
Sage Creek	11-21-47	Barnsdall Oil Co.	3,097	57 & 58N., 97 & 98W.	Oil dis.
Sage Spring Creek	6-29-48	Amerada Pet. Corp.	30,500	36, 37 & 38N., 77 & 78W.	
Salt Creek	9- 1-39	Stanolind Oil & Gas Co.	15,338	39 & 40N., 78 & 79W.	Oil
Sand Coulee	12- 8-47	Stanolind Oil & Gas Co.	6,325	55 & 56N., 100W.	Drg.
Sand Creek	10-13-47	General Pet. Corp.	9,579	46 & 47N., 91W.	Oil dis.
Segment Basin	11- 1-36	Lakota Oil & Gas Co.	8,477	36 & 37N., 81W.	Dry
Snider Basin	4- 3-47	California Company	40,453	29 & 30N., 114 & 115W.	Dry
South Baggs	9- 1-46	Phillips Pet. Co.	10,655	12N., 92 & 93W.	Dry
South Baxter Basin	11- 1-42	Mountain Fuel Supply Co.	38,768	15 to 18N., 103 to 105W.	Gas
South Cole Creek	4- 7-48	Phillips Pet. Co.	4,881	34 & 35N., 76 & 77W.	Oil dis.
South Elk Basin	12- 1-44	Continental Oil Co.	7,022	57N., 99W.	Oil & gas dis.
South Fork	11- 1-47	General Pet. Corp.	4,274	46N., 91 & 92W.	Oil
South Shoshone	6-17-47	Continental Oil Co.	4,930	50N., 104 & 105W.	Oil dis., S.I.
South Sand Draw	11- 1-45	Sand Draw Oil Co.	2,812	31 & 32N., 94 & 95W.	Gas dis.
South Spring Creek	4- 1-38	Texas Company	3,453	49N., 101 & 102W.	Oil
Spread Creek	4- 9-48	Stanolind Oil & Gas Co.	24,160	43 & 44N., 112 & 113W.	Drg.
Sussex	12-29-47	Continental Oil Co.	13,376	42N., 78 & 79W.	Oil dis.
Sweetwater	4-19-48	Carter Oil Co.	7,266	29N., 96 & 97W.	Loc.
Table Rock	10- 1-45	Texas Company	12,692	18 & 19N., 97 & 98W.	Gas dis., S.I.
Tip Top	2-19-48	General Pet. Corp.	23,812	27, 28 & 29N., 113W. 28N.; 114W.	Drg.
Tisdale Anticline	7-21-48	Tidewater Assoc. Oil Co.	41,212	40, 41 & 42N., 80 & 81W.	Loc.
Wagonhound	2- 1-44	F. Goodstein	2,197	44 & 45N., 97 & 98W.	Oil dis.
Waugh	1- 9-35	Honolulu Oil Corp.	2,419	44N., 96 & 97W.	Oil
Werts	12- 1-37	Sinclair-Wyo. Oil Co.	2,415	26N., 89 & 90W.	Oil & gas
West Mule Creek	8- 1-37	K. S. Barnett	4,206	39 & 40N., 61W.	Oil
West Poison Spider	8-13-47	Pure Oil Co.	15,873	33 & 34N., 83, 84 & 85W.	Oil dis.
Whiskey Peak	7-17-47	British-American O. P. Co.	5,753	26 & 27N., 91W.	Drg.
Worland	8- 1-45	Pure Oil Co.	24,646	47 to 49N., 92 & 93W.	Oil dis.
Wyoming Anticline	11- 1-38	K. P. M. Inc.	8,328	25, 25½ & 26N., 114 & 115W.	Dry
Zimmerman Butte	9- 1-45	Pacific West. Oil Corp.	2,576	43 & 44N., 92 & 93W.	Oil dis.

Symbols used for drilling or producing status in column 6:

Oil—Oil field when unitized.
Oil dis.—Oil discovery under unit.
Gas—Gas field when unitized.
Gas dis.—Gas discovery under unit.
S.I.—Field presently shut in.
Dry—Dry hole drilled under unit.
Loc.—Location 9-1-48.
Drg.—Drilling as of 9-1-48.

From U. S. Geological Survey, Casper, Wyoming.

Sieger New President of American Welding Society

George N. Sieger

The American Welding Society has elected George N. Sieger of Detroit as its president for the year 1948-49. Sieger is president of the S-M-S Corporation, Detroit, and a national authority on resistance welding. He is a past president of the Resistance Welder Manufacturers Association and during the war he served as chairman of the Task Committee, Resistance Welding Electrodes Advisory Committee. He was also a consultant on cemented tungsten carbides for the Cutting Tools Section staff.

Sieger is a graduate of Lehigh University with a degree of Electro Metallurgist. Sieger is a member of the American Society for Metals and the Society of Automotive Engineers.

Resume Ethiopian Operations

Sinclair Petroleum Company, a subsidiary of Sinclair Oil Corporation, holding the Ethiopian Oil concession, announced that they would resume exploratory and drilling operations in the Ogaden area of Ethiopia. These operations were suspended some months ago because of local disturbances. Since that time, agreement has been reached between British authorities and the Ethiopian Government for effective police protection. Equipment already on the ground is available for immediate use.

Basrah Claims

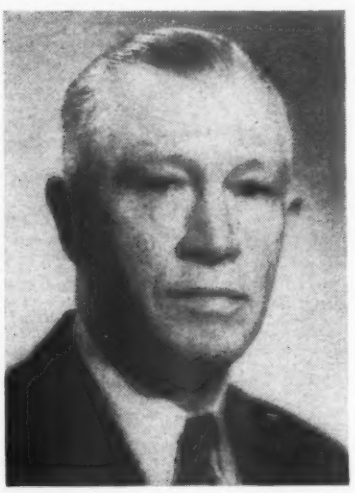
Baghdad newspapers recently quoted an official source as saying that Basrah Oil Company has discovered rich oil deposits in one of the hitherto unexplored Basrah areas. This area is included in a concession granted to a British oil firm.

The reports said exploratory research established the existence of oil in many parts of the region, and that the Basrah Oil Company now is completing exploration to start production next year.

The company obtained an exclusive concession in southern Iraq in 1938.

Humble Oil Elects Barrow

Election of L. T. Barrow as chairman of the board of directors of Humble Oil and Refining Company was announced by Hines H. Baker, president and chief executive officer of the company. Barrow has been with the company since 1924, a director since 1937, and vice president since 1938. Baker stated that Humble's board feels extremely fortunate in having L. T. Barrow assume his new position. His contribution to the progress of the company, particularly in the field of exploration, has been outstanding and a primary factor in the favorable position Humble occupies as a holder of crude oil and gas reserves and as a producer.



L. T. Barrow

A native Texan, Barrow's studies at the University of Texas were interrupted by the first World War. He served in the Air Corps then returned to the University where he specialized in geology and received his B.A. degree in 1921 and his Masters degree in 1923. He was elected to Sigma Gamma Epsilon honorary geologic fraternity. He served as an instructor of geology at the University of Texas for two years prior to joining the Humble Company as a division geologist in 1924.

Barrow organized Humble's gelologic work in the San Antonio division in the years immediately after joining the company. He was appointed chief geologist for the company in 1929 and occupied that position until February, 1937 when he was elected to the board of directors of the Humble Company. During that period of time, Humble carried on an aggressive program of exploration, which added greatly to its reserves of crude oil and natural gas. Since 1937 Barrow has been the director in charge of the company's exploration activities.

AIME, North Texas Section, *through its chairman, Warren J. Jackson (center), has signed affiliation agreements with the Department of the Army to sponsor certain Military Intelligence Reserve Units. Lt. Col. Harry H. Werner (left) represented the Fourth Army in the signing of these agreements. Lt. Col. Jack A. Crichton, MIR, and a member of the AIME, will command these units. Col. Crichton (right) is chairman of MIR Committee for North Texas Section.*

Take advantage of HYATT Experience

As builders of the first, and today the finest roller bearings, Hyatt, in more than half a century, has accumulated a lot of application experience which should be helpful to you.

Hyatt engineers are at your service, glad to assist you in solving your bearing problems whether you are designing a new machine or piece of equipment or modernizing an existing design.

Hyatt Roller Bearings are used by thousands of leaders in the automotive–industrial–agricultural–petroleum–construction and transportation fields. Costs you nothing to invite a Hyatt man to confer with you. Hyatt Bearings Division, General Motors Corporation, Harrison, N. J.

HYATT ROLLER BEARINGS

LAUGH WITH BARNEY

Al: There's a fellow who is going places!

Pal: Ambitious guy, huh?

Al: Nope, his wife is out of town.

* * *

Little boy: Why is it that cream costs more than milk?

Milkman: Because it's harder for a cow to sit on the little bottles.

* * *

The hunter came panting up to one of the party.

"Just met a great big bear in the woods," he said breathlessly.

"Good!" said the other. "Did you give him both barrels?"

The hunter wiped his perspiring brow.

"Both barrels!" he returned, "I gave him the whole gun!"

* * *

Sailor (at stage door): Is the hula dancer in her dressing room?

Watchman: Son, she's 'round at the rear.

Sailor: Answer my question.

* * *

At the beach most girls wear baiting suits.

* * *

"Why is it, I wonder, that redheads always marry such shriveled up little men?" asked Flossie.

"They don't," replied Mamie. "The men get that way."

"So you met your wife at a dance; wasn't that romantic?"

"No, it was embarrassing. I thought she was home minding the kids!"

* * *

When a grass widow makes hay while the sun shines, you can be sure there's a rake around.

* * *

Our friend Lulu is a card—she thinks a sandbag is a desert woman.

* * *

Baby kangaroo kept jumping out of mama's pouch. Papa kangaroo kept putting him back. Finally Papa slapped baby's ears and slammed him back in for the 20th time. "You shouldn't have done that," said Mama. "can he help it if I've got hiccups?"

* * *

"That old maid I had a date with is airplane-minded."

"Why?"

"She wants to B-29."

* * *

"Good night," she purred at the door, "It was fun 'noing' you."

* * *

A stenographer defines a wolf as a modern dry cleaner. He works fast and leaves no ring.

* * *

"What's worse than being a bachelor?"

"Being a bachelor's son."

Today's long skirts are tough on fellows who can't remember faces.

* * *

A gentleman slipped on the stair of a subway and started to slide down to the bottom. Half-way down, he collided with a lady, knocking her down, and the two continued their way to the lower landing.

After they had reached the bottom, the lady, still dazed, continued to sit on the gentleman's chest. Looking up at her, he finally said politely, "Madam, I'm sorry, but this is as far as I go."

* * *

"You say this woman shot her husband with this pistol and at close range?" asked the coroner of the eye-witness to the tragedy.

"Yes, sir."

"Were there powder marks on his face?"

"Yes, sir: that's why she shot him!"

* * *

"Which has more legs," asked the little boy, "a cow, or no cow?"

Puzzled, the fond parent did not know, but ventured the guess that a cow had more legs.

"No cow has eight legs," replied the young hopeful.

* * *

Two men were working on the White House lawn, each supplied with a small push cart upon which was a garbage can. They walked about picking up papers with a long spear. One spied a piece of tissue and started to spear it, when suddenly a gust of wind came up and blew the paper into the White House through an open window.

The man became frantic and rushed into the building. He returned shortly after and said: "I was too late. He had already signed it."

* * *

Jackson and his wife were doing a little fly hunting about the house.

"How many have you caught?" she asked after a while.

"Six," replied her husband, "three males and three females."

"How absurd!" his wife sniffed. "How could you tell if they were males or females?"

"Easy, my dear," he retorted. "Three were on the sugar and three were on the mirror."

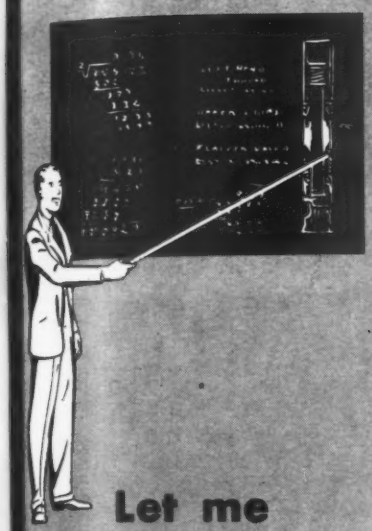
* * *

Boy: But officer, you can't arrest me, I came from one of the best families in North Carolina.

Cop: That's all right, buddy. I'm arresting you for speeding, not breeding purposes.

* * *

For every man over 85, there are seven women—but it's too late then.



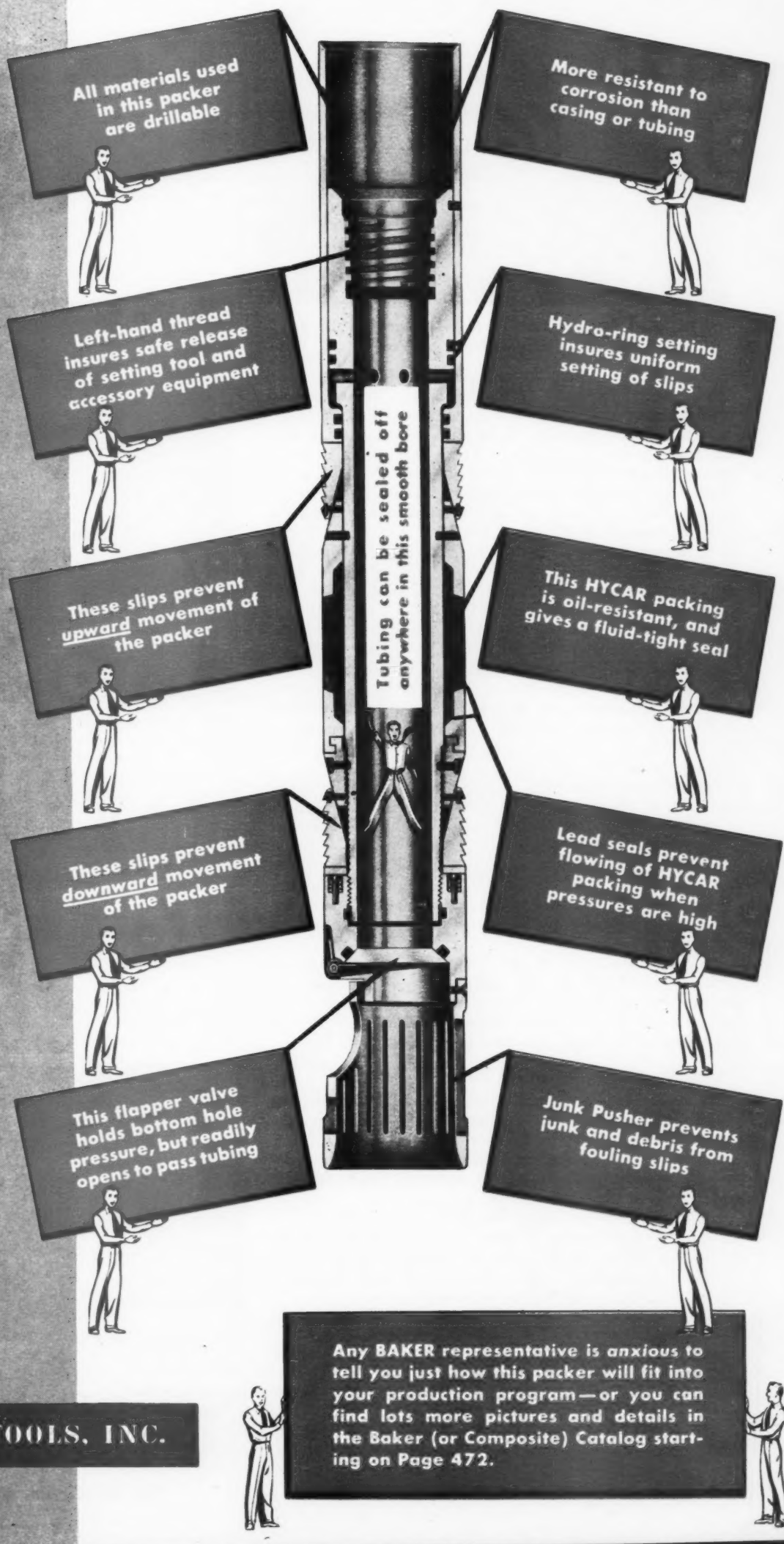
Let me point out a few of the outstanding features that make the

BAKER

RETAINER PRODUCTION PACKER

(Product No. 415-D).

FIRST CHOICE EVERYWHERE


All materials used in this packer are drillable
More resistant to corrosion than casing or tubing
Left-hand thread insures safe release of setting tool and accessory equipment
Hydro-ring setting insures uniform setting of slips
Tubing can be sealed off anywhere in this smooth bore
These slips prevent upward movement of the packer
This HYCAR packing is oil-resistant, and gives a fluid-tight seal
These slips prevent downward movement of the packer
Lead seals prevent flowing of HYCAR packing when pressures are high
This flapper valve holds bottom hole pressure, but readily opens to pass tubing
Junk Pusher prevents junk and debris from fouling slips

Any BAKER representative is *anxious* to tell you just how this packer will fit into your production program—or you can find lots more pictures and details in the Baker (or Composite) Catalog starting on Page 472.

BAKER OIL TOOLS, INC.

Dedicate Hunter Memorial Hall

V. C. Perini, Jr., William H. Boyd, Jr., Eugene Holman, Fred Shields, and Frank M. Porter at Hunter Memorial.

Hundreds of independent operators, major company executives, and friends of the late Judge Jesse Coleman Hunter gathered in Abilene from all parts of the nation to dedicate a new womens' dormitory building at Hardin-Simmons University in Abilene, Texas, in memory of Judge Hunter. Leaders of the petroleum industry of America who officiated at the recent dedication are: (l to r) V. C. Perini, Jr., president of West Central Texas Oil and Gas Association; William H. Boyd, Jr., president of API; Eugene Holman, former student at Hardin-Simmons and now president of Standard Oil Company (New Jersey); Fred Shield, president of the IPAA; and Frank M. Porter, president of Mid-Continent Oil and Gas Association.

Ceremonies included memorial services in Behrens Chapel, and the unveiling of a bronze plaque at Hunter Memorial Hall. George A. Hill, Jr., president of the Houston Oil Company and a close friend of the late Judge, delivered the memorial address. Dr. Rupert N. Richardson, president of Hardin-Simmons University, delivered the response to Mr. Hill's address. A chuck wagon luncheon in Rose Field House preceded the services.

Judge Hunter, who died in 1945, had been a prominent leader in civic and petroleum industry affairs, having been an independent oil operator, president of the Chamber of Commerce, president of the West Central Texas Oil and Gas Association, a member of the Interstate Oil Compact Commission, president of the Texas Mid-Continent and the General Mid-Continent Oil and Gas Association, and chairman of the Board of Trustees of Hardin-Simmons University.

The presentation of Hunter Memorial Hall to Hardin-Simmons University by the men of the oil industry of America through the J. C. Hunter Memorial Fund fulfills a task initiated by the beloved pioneer before his death and serves as a useful living memorial to his memory.

Export Quota of Residual Fuel Oil Set

An export quota of 1,450,000 bbl of residual fuel oil (Schedule B Number 503100) has been established for the fourth quarter of 1948 and export licenses are now being issued against this quota, the Department of Commerce announced through its Office of International Trade. This is the same as for the third quarter.

The decision to permit the licensing of residual fuel oil shipments now against the fourth quarter quota was made to aid in relieving pressure on storage facilities, OIT officials explained. Residual fuel oil requires special tanks equipped to heat the oil temperatures at which it can be pumped.

The special facilities required for storing residual fuel oil in the coastal areas have been filling up rapidly and some refineries have been forced to reduce operations because of inadequate storage space. On August 14, 1948, inventories at refineries and bulk terminals totaled 61 million bbl, compared with 48 million bbl a year ago.

Advance licensing of residual fuel oil shipments will enable importing countries to increase their stocks in advance.

Nomads Party at Baltusrol Club, New Jersey

New York Nomads held a golf party at the Baltusrol Golf Club in Springfield, New Jersey. Prizes were won by the following Nomads: John Evans, Lucey Export Corporation, low gross, winner of President's Cup; K. B. Ris, The Griscom-Russell Company, low net; Stew Beckley, Brown & Beckley, nearest to pin; Joe Woods, *The Petroleum Engineer*, longest drive; H. Gottwald, Rockwell International, fewest putts; George Woods, R. S. Stokvis & Sons, boobie prize; Jeff Tucker, Mission Manufacturing, gin rummy.

Prize winners among the guests were: Bill Dickenson, Standard Oil Development Company, low gross; John Basehart, Buda Engine Company, low net; Harry McCobb, Standard Vacuum Oil Company, nearest to pin; Joe Doran, International General Electric Company, longest drive; R. H. McKegg, Socony-Vacuum, fewest putts; R. E. Irby, Socony-Vacuum, boobie prize; Bill Cardwell, Cardwell Manufacturing, gin rummy.

MAIN PRIZE WINNERS. *Standing: John Basehart, Buda Engine; John Evans; Bill Dickenson, Standard Development; K. B. Ris, Griscom-Russell. Kneeling: Joe Doran, International General Electric; R. H. McKegg, Socony-Vacuum; H. Gottwald, Rockwell International.*

AWARDING OF PRESIDENT'S CUP. *Nomad President Val Wittich, right, presenting the President's Cup to low gross winner, John Evans of Lucey Export Corporation.*

FOREIGN GUESTS: *Joe Doran, John Henry, La Compania Petrolera Lobitos; Joe O'Farrell, International General Electric; Dr. Oliver Hopkins, Imperial Oil; A. E. Johnson, Caribbean Petroleum.*

LOW COST POWER handles the biggest jobs—pipe lines, refineries, multiple pumps—with trouble-free efficiency. If the job is only a fractional horsepower motor, Utility Electric LOW COST POWER is your best bet, too. You get all the advantages of low operating, maintenance and labor costs . . . easy portability . . . fast starting in all weather . . . s-l-o-w depreciation. Save on the initial cost of power-driven equipment. Save on repairs. Call your nearest Utility Electric Power Company. The Power Engineer will show you how LOW COST POWER fits into your picture.

Everything's up except Utility Electric Power costs!

Use Utility Electric Power!

PETROLEUM ELECTRIC POWER ASSOCIATION

Utility ELECTRIC POWER

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NEWS

Dresser wins Report Oscar

In the final ratings of an independent board of judges for the Financial World Annual Report Survey, Dresser Industries, Inc., Cleveland, Ohio, was judged as having the best 1947 annual report *for the fourth consecutive year.*

The bronze "Oscar of Industry" trophy will be presented to Dresser Industries, Inc., at the annual awards banquet in Hotel Pennsylvania in New York on October 21, 1948.

More than 4000 corporation annual reports were submitted in this national survey, the eighth in the series, and these were judged in one hundred industrial classifications for "Best of Industry" awards.

In the building equipment industry category, York Corporation, York, Pennsylvania, was runner-up for top honors, while Minneapolis-Honeywell Regulator Company, Minneapolis, Minnesota, took third place.

Weston Smith, vice president of Financial World and originator of the annual report surveys, will present the "Oscar of Industry" trophies at the annual awards banquet, which will be attended by more than 1000 business leaders from all over the country.

Cooper-Bessemer Opens Branch Office in Chicago

Expansion of the Cooper-Bessemer Corporation's nationwide sales facilities, through the addition of a Chicago branch office, was announced by Stanley E. Johnson, vice president and director of sales.

The new office, located at 122 South Michigan Avenue, in the People's Gas

Robert S. Bowie — Charles L. White

Building, will be under the direction of Robert S. Bowie, who has been associated with Cooper-Bessemer since 1936 in other sales capacities. Bowie's activities will continue under the supervision of Charles L. White, district manager for Cooper-Bessemer in the North Central area. White's headquarters are in the company's Mount Vernon offices.

Petroleum Companies Scholarships Awarded

The Petroleum Engineering School of the University of Oklahoma announces the appointment of William W. Owens as holder of the Stanolind Oil and Gas Company Graduate Fellowship for the coming academic year. Owens, a graduate of the Colorado School of Mines in 1947 is a native of Colorado. He is a member of Sigma Gamma Epsilon, the American Institute of Mining Engineers, and the Oklahoma National Guard. Before accepting appointment to this fellowship, Owens was employed in research studies in petroleum engineering at Tulsa. He is married and has two children.

The Stanolind Oil and Gas Company's Fellowship is granted for fundamental research studies on the displacement of oil from reservoirs. Pete Cawthon was the recipient of this award during the past year.

The Shell Fellowship in Petroleum Engineering has been awarded for the coming academic year to Marsh S. Watson, Jr. Watson, a native of Plainview, Texas is a graduate of the New Mexico School of Mines. Watson has been employed both in the States and in South America as a petroleum engineer. He is a member of AIME and the author of technical publications. He is married and has one child.

The Shell Fellowship, awarded for graduate study in petroleum engineering was held last year by Maurice Lewis.

Jimmy D. Harrington of Pecos, Texas, has been designated by the faculty of the School of Petroleum Engineering and the Graduate College as the recipient of the Humble Oil and Refining Company's Fellowship in petroleum engineering for the coming academic year. Harrington is a graduate of Texas A&M College. He has field experience with the Gulf Oil Corporation and the Stanolind Oil and Gas Company.

The Humble Fellowship, which has been set up for fundamental studies in petroleum engineering, by graduate students, was held last year by William Vestal.

Organize Oil Company

W. J. "Swede" Larson, formerly manager of California field operations for the Union Oil Company, announces the formation of the Yellowstone Oil Company, of which he is president. The first project will be the drilling of a well in the Santa Maria Valley, to spud in the very near future.

The offices of the Yellowstone Oil Company are in Room 1000, Bankers Bldg., 629 S. Hill St., Los Angeles.

New Laboratory Planned

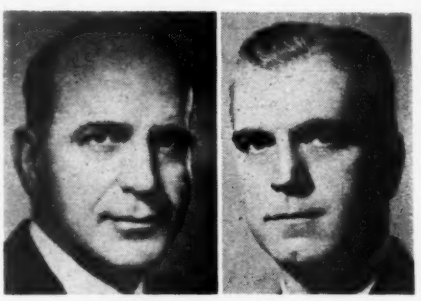
To house additional laboratories required for its ever-expanding research, Battelle Institute, Columbus, Ohio, will begin construction of a new half-million-dollar laboratory building late this year. The structure, according to director Clyde Williams, is scheduled for completion in 1949.

This major addition to the Institute will be the largest of four laboratory structures erected by Battelle since World War II.

According to Williams, the three-story structure will contain space for 103 unit laboratories, plus large open areas for pilot plant operations. It will contain approximately 80,000 sq ft.

ACF Appointments

American Car and Foundry Company announces the appointment of Frank B. Powers as assistant vice president, production department. Powers comes to ACF from the Baldwin Locomotive Works of Philadelphia, Pennsylvania. He was graduated from the University of Illinois in 1926



Frank B. Powers — T. C. Ballou

with a B.S. in electrical engineering. From 1926 until 1944 Mr. Powers served with the Westinghouse Electric Corporation in the engineering and manufacturing fields. From 1942 until the termination of the war he served as overseas traction manager for Westinghouse. During this period he traveled widely in South America, North Africa, the Near East, Soviet Russia and Scandinavian countries.

Leaving Westinghouse he became vice president of Great American Industries, Inc., and in 1947 he assumed the duties of vice president in charge of engineering at Baldwin.

Another appointment of ACF is that of T. C. Ballou to the post of sales agent at New York, representing ACF in the northeastern railroad area.

A graduate of Western Reserve University Ballou has been with ACF since 1936. Since that time he has specialized in welded products and tank cars.

A lieutenant in the U. S. Naval Reserve, he was on active duty with the Navy from 1942 to 1946, serving in the Atlantic theater of war.

UN Steel Contract

A contract for the furnishing and erection of the steel of the 40-story Secretariat Building of the United Nations to be erected at the East River in New York City, was awarded to the American Bridge Company, U. S. Steel Corporation subsidiary, it was announced by F. K. McDanel, president of American Bridge.

This will be the first structure in the permanent home of the United Nations to be built on the New York City site. About 13,000 tons of steel will be required for the towering Secretariat structure, which will be 72 ft wide and 287 ft long. The building will comprise 39 floors and a penthouse.

Appointed Vice President

Lyle A. Christensen, general sales manager of The Marley Company, Inc., manufacturers of water-cooling equipment, was recently appointed a vice president of the company.

Christensen has been with Marley seven years. He was sales engineer in

Lyle A. Christensen

the New York office for five years, moved to the home office in Kansas City in 1946, and became general sales manager in 1947.

Before joining the Marley Company, Christensen worked for the Ingersoll-Rand Company for 12 years. He received his degree in Mining Engineering from the University of Minnesota.

New Club Rooms

The Petroleum Club of Houston announced that space has been obtained in the Lamar Hotel for permanent club quarters and that a membership drive is now under way.

The club will open its door about March 1. The space it will occupy is the ballroom and adjacent space on the fourth floor of the hotel. Work will be started on the club's quarters soon.

Membership in the club is limited. A number of nonresident memberships will be made available. Eligibility for membership is confined to those either engaged in the oil and gas industry or closely associated with it and deriving their income from it.

New Office for Trinity

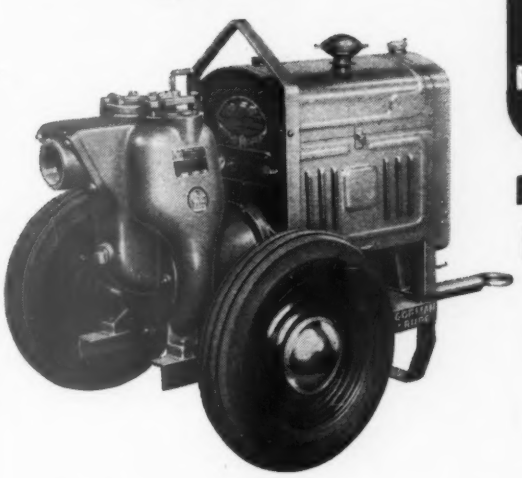
Trinity Equipment Corporation has announced the consolidation of their general offices and factory in a new, completely modern building, especially designed and erected for the production of thermowells.

This new one-story building is located at 472 Westfield Avenue East, Roselle Park, New Jersey. The building embodies many of the latest scientific developments and will house the last word in production machinery. It will be devoted exclusively to making thermowells and metal specialties for the process industry.

Westinghouse to Buy Plant

Westinghouse Electric Corporation announced its decision to purchase the 57-acre Sunnyvale Works, California, leased 19 months ago from the Joshua Hendy Iron Works. Robert A. Neal, vice president and general manager of western operations for Westinghouse, made the announcement and revealed that purchase price of the plant—largest electrical manufacturing plant in the entire West—was $3,472,151. Westinghouse took over operation of the Sunnyvale plant March 1, 1947, under terms of a 10-year lease with option to purchase.

NEW.... Complete Line of Gorman-Rupp Heavy Duty Pumps



Challenging Any Pump, Size for Size to

PRIME AS QUICK
PRIME AS HIGH
PUMP MORE DIRTY WATER
MATCH PERFORMANCE

Gorman-Rupp Self-Priming Centrifugal Pumps have long led the field in dependability and performance. NOW! Gorman-Rupp goes further ahead with its new line of Heavy Duty Pumps.

Streamlined inside, where streamlining counts, they are the quickest priming, fastest pumping, never-quit pumps available.

For instance -- the new Model 40M 4" pump primes at 20 ft. suction in just 33 seconds; 30 ft. suction in 67 seconds (sea level).

Gorman-Rupp's challenge is not idle talk. Our distributors will put a pump on the job alongside any other make, size for size. Unless our pump proves to be the best all around pump, its return will be accepted and the user paid for any installation expense incurred.

MID CONTINENT OIL FIELD REPRESENTATIVE

TOM L. TURNER

1335 MELLIE ESPERSON BLDG., HOUSTON 2, TEXAS

THE GORMAN-RUPP COMPANY

For Better Pumping at

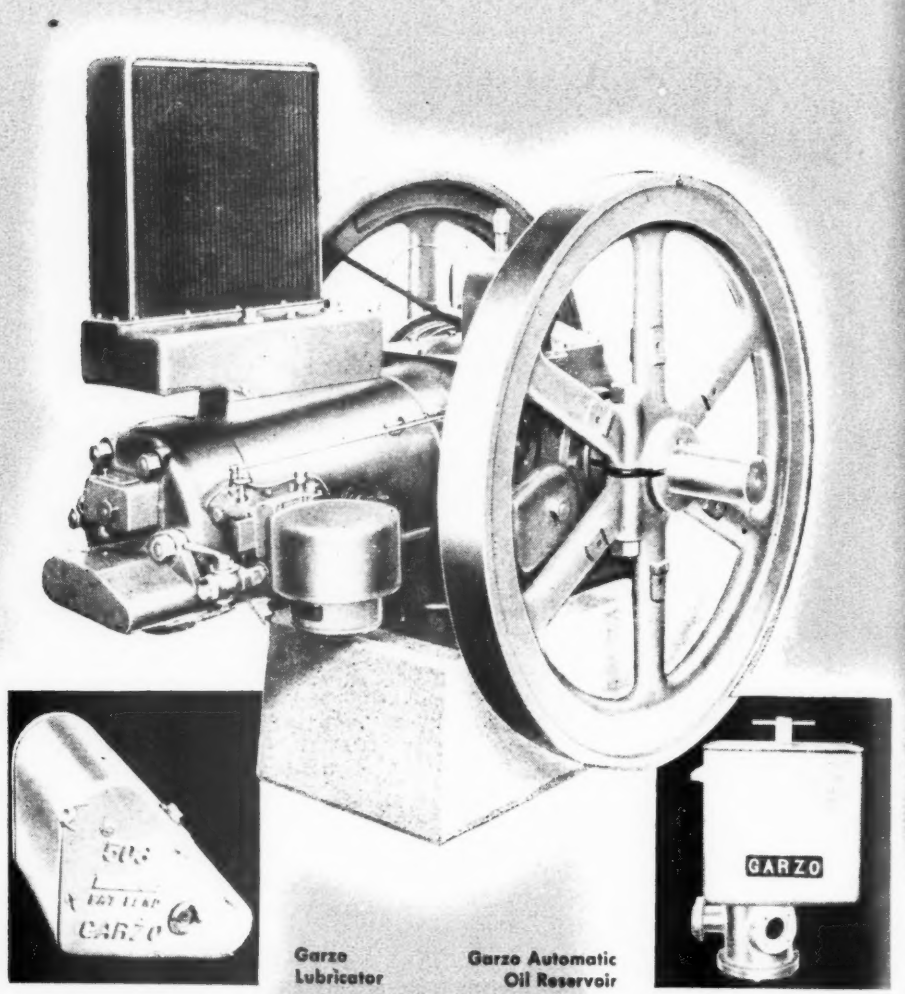
REPUBLIC

Brings You These Leading Production Equipment Lines

American Manufacturing Company
Bradford Motor Works
Buda Company, (The)
Cameron Iron Works
Chaplin Fulton Manufacturing Co.
Fairbanks-Morse & Company
Garzo Products Company
Gates Rubber Company
B. F. Goodrich Company
Goodyear Tire & Rubber Company
Harbison Fischer Manufacturing Company
Hercules Motor Company
Chas. N. Hough Manufacturing Co.
J. M. Huber Corporation
Hughes Tool Company
International Derrick & Equipment Co.
S. M. Jones Company
McEvoy Company
Maloney-Crawford Tank Company
Miller Sand Pump Company
W. C. Norris Manufacturer
Walter O Bannon Company
Oil Center Tool Company
Pacific Pumps, Inc.
Rector Well Equipment
Reda Pump Company
Sterling Packing & Gasket Co.
Stockham Pipe Fittings Co.
Tretolite Company
United States Rubber Company
Victaulic Company, of America
W-K-M Company
Waukesha Sales & Service, Inc.

Fairbanks-Morse ZC Engines

Equipped with Garzo Lubricators and Garzo Automatic Oil Reservoirs



Garzo Lubricator

Garzo Automatic Oil Reservoir

Check these outstanding features which make ZC slow-speed, horizontal heavy-duty engines the best buy in the field . . . Vapor cooling . . . roller bearings . . . extra heavy flywheels . . . self-oiling . . . fully enclosed . . . gas-gasoline carburetors . . . governors . . . gasoline starters with battery ignition.

Equipped with Garzo Lubricators you get easier starting . . . easier valve mechanism . . . better performance.

The Garzo Automatic Oil Reservoir eliminates shutdowns for replenishing oil . . . provides improved oil storage for longer operation without attention . . . makes easier, safer gauge readings.

Experienced operators have learned to appreciate these extraordinary features for providing reliable service . . . they have found that ZC will do a better job at less cost than other prime movers.

Less Cost Republic Offers

Heavy demand for crude oil and current high prices emphasize the need for modern and efficient production equipment to assure maximum output and increased profits.

REPUBLIC has the answer with its carefully selected and coordinated line of production equipment which meets every requirement from a single marginal producer to the most prolific producing lease.

For maximum efficiency at low cost call

REPUBLIC

"Your Supply Store"

Fairbanks-Morse ZC Pumping Engines are only one of the many lines of distinguished products associated with Republic Supply Service.

Republic Supply

COMPANY

GENERAL OFFICES · · · HOUSTON 1, TEXAS

YOUR SUPPLY STORE

REPUBLIC SERVES YOU FROM THESE POINTS

ARKANSAS
El Dorado, Patmos

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COLORADO,
Denver

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ILLINOIS
Chicago, Grayville
McLeansboro, Salem

•

KANSAS
Ellinwood, Russell, Wichita

•

LOUISIANA
Haynesville, Lake Charles,
Mamou, New Iberia,
Rodessa, Shreveport

•

MISSISSIPPI
Hattiesburg, Jackson

•

NEW MEXICO
Artesia, Eunice, Hobbs

•

OKLAHOMA
Bartlesville
Cement, Elmore City,
Oklahoma City,
Seminole, Tulsa

•

TEXAS
Abilene, Alice, Big Spring,
Borger, Columbus,
Corpus Christi, Dallas, Electra,
Falfurrias, Fort Worth, Freer,
Hebbronville, Houston, Kamay,
Kenedy, Kilgore, Nocona,
McAllen, Odessa, Olney,
Pampa, Pleasanton,
San Antonio, Sundown, Talco,
Victoria, Wichita Falls.

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WYOMING
Casper

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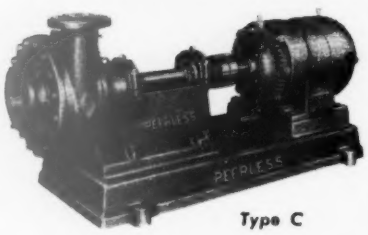
General Offices
Houston, Texas

TYPE C

PEERLESS
Centrifugal
PUMPS

FOR PROCESS SERVICES



Type C

TYPE C ENCLOSED IMPELLER

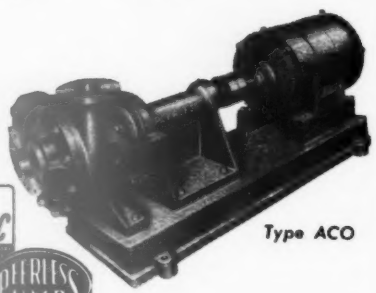
Designed to handle clear liquids which can be of corrosive nature. Single-stage, single-end suction design; range of capacities from 10 to 1200 g.p.m.; heads up to 231 feet; maximum working pressure of 150 lbs.

TYPE CO OPEN IMPELLER

Utilizes an open impeller to permit pumping of fluids up to 750° F with solids in suspension, brines, sludges, etc. Capacities from 10 to 1200 g.p.m.; heads to 231 feet; maximum working capacity of 150 lbs. All forms of drive. Both of the above pumps are described in Bulletin 810.

TYPE ACO FOR ACIDS AND CAUSTICS

Especially designed to pump caustics and acids. Handles fluids up to 800 g.p.m.; heads to 231 feet; maximum working pressure of 150 lbs. Temperatures should not exceed 300° F. Described in Bulletin D-2400.



Type ACO

fmc PEERLESS PUMP

PEERLESS PUMP DIVISION
FOOD MACHINERY & CHEMICAL CORPORATION
Factories: Indianapolis, Ind.; Los Angeles 31, Calif.
District Offices: New York 5, 37 Wall Street; Chicago 40, 4554 North Broadway; Atlanta Office: Rutland Building, Decatur, Georgia; Dallas 1, Texas; Fresno, California; Los Angeles 31, California.

NEWS

"Oil Progress Day" Celebrated Throughout U. S.

Reports of the outstanding success of the efforts of the oil companies of America to tell the story of their industry on "Oil Progress Day," October 14, have been received by the Oil Industry Information Committee.

The first reports told of governors and mayors issuing proclamations setting October 14 as "Oil Progress Day" in their respective states and communities. Oil men and women in several thousand communities, said the reports, carried the progress story of their industry to their friends and neighbors with meetings, speeches, parades; open houses at refineries, bulk plants, pipe line terminals, company offices, and service stations. There were exhibits, radio programs, special newspaper sections, tie-in advertising, the distribution of literature, and the showing of industry films to business groups and school children. With thousands of oil companies participating at the community level, it probably was the most successful information event ever carried out by an industry.

International Gas Conference

The Fourth International Gas Conference sponsored by the International Gas Union will be held in London June 15-17, 1949. The International Gas Union is comprised of national gas associations throughout the world, with headquarters at London and Zurich. International activities which were interrupted during the war were resumed in 1946.

At the meeting reports prepared by national associations and papers submitted by individual members will be presented. Papers and discussions will cover all phases of gas making, including manufacture, distribution, utilization, research, and statistics. Participants at the conference also are invited to attend the 86 annual meeting of The Institution of Gas Engineers which will be held in London on June 13 and 14, 1949.

Export Team

Export activities of Warner Machine Products, Inc., of Muncie, Indiana, will be handled by Borg-Warner International Corporation. The arrangement was announced jointly recently by Abbott L. Johnson, president of Warner Machine Products, and J. W. DeLind, Jr., president of Borg-Warner International.

Tulsan Heads AISC

N. R. Patterson, president of the Patterson Steel Company, pioneer manufacturers and fabricators of steel products, was elected president of the American Institute of Steel Construction, Inc., at the recent national convention at Chateau Frontenac, Quebec, Canada.

Director and past president of the Central Fabricators Association, Patterson also serves as a director of the National Association of Manufacturers and Beaver, Meade and Englewood Railroad. He was a director and vice president of AISC prior to his election to the presidency.

AISC, a non-profit service organization supported entirely by membership dues, was organized in 1921. Its current membership includes more than 220 of the nation's concerns, which normally fabricate and erect more than 85 per cent of the country's annual tonnage for buildings, bridges, and other steel structures.

Made Midwest Manager

William H. Flanagan has been appointed regional manager of the midwest by the Granberg Corporation, 1308-67th Street, Oakland, California. Flanagan's headquarters are at 20 East Jackson Boulevard, Chicago, Illinois, and his territory includes Wisconsin, Minnesota, Iowa, Eastern Missouri, Illinois, Indiana, Ohio, Michigan, and Northern Kentucky. Granco pumps and meters are sold in this area through distributors.

Imported Pencils Arriving

J. S. Staedtler, Inc., of 53 Worth Street, New York City, has again started to import its well known No. 2886 Mars-Lumograph drawing pencils. All imports are coming from the American Zone of Germany, and they are the first drawing pencils to be imported since the outbreak of hostilities in 1939. R. J. Urmston, president of J. S. Staedtler, Inc., feels that the return of these fine pencils to the American market will be greeted by eager acceptance in the quality field in the drawing material market. Also available, as in the past, are the companion lines to the above, No. 1018 Mars-Lumograph artist (Chuck) pencils and No. 1904 Mars-Lumograph artist leads.

Death of M. R. Rosse

Mathew R. Rosse died at the Mountainside Hospital October 7 after a brief illness. He was 50 years old. At the time of his death he was export manager of The Colorado Fuel and Iron Corporation. He was associated with the exportation of steel products and industrial equipment for 25 years.

D. W. Haering Opens New Unit

A new plant at San Antonio, Texas, will provide increased facilities for this rapidly growing business. Provision has been made for increased laboratory, operating, and warehouse space. It will give faster service to the rapidly developing industrial empire in the Southwest, as well as providing an adjunct to Haering Service throughout the entire country.

A. W. Rice Promoted

Appointment of A. W. Rice as company auditor is announced by C. T. Ruhf, president of Mack Trucks, Inc. For 27 years intimately concerned with the company's auditing affairs, Rice joined Mack in 1921 as cashier in its Albany division office. In 1923 he was appointed division auditor for that territory, which position he held until his transfer to Mack's New York office in 1926. Since 1936 he has been auditor for all of Mack's 67 direct factory branches.

In assuming his new position Rice replaces the late H. S. Conklin whose recent death ended a 36-year career with Mack.

The company's home offices in New York City's Empire State building will continue to be Rice's headquarters.

Distributor Named

Republic Supply Company, Houston, Texas, has been named distributor of industrial rubber products for Goodyear Tire and Rubber Company. Announcement of the new distributorship was made recently by both Don L. Collins, Republic vice president and sales manager, and H. E. Langdon, western sales manager of Goodyear's mechanical goods division, Akron, Ohio.

One of the largest supply houses in the west, the Republic firm maintains seven district offices and operates 48 service stores in the mid-continent oil field. Langdon said principal rubber mechanical goods used by the petroleum industry are several types of special-service hose, V-belts, flat belting, sheet packing and molded rubber goods.

Opens New Offices

John C. Riley, Jr., for the past five years office manager with A. O. Smith Corporation in Houston, has opened offices at 407 Scanlan Building, Houston. Among the firms that Riley represents are: The Midvale Company, Philadelphia; Diamond Saw Works, Inc., Buffalo, New York; Reading Chain and Block Corporation, Reading, Pennsylvania; and Electric Steel Foundry Company, Portland, Oregon, and Houston.

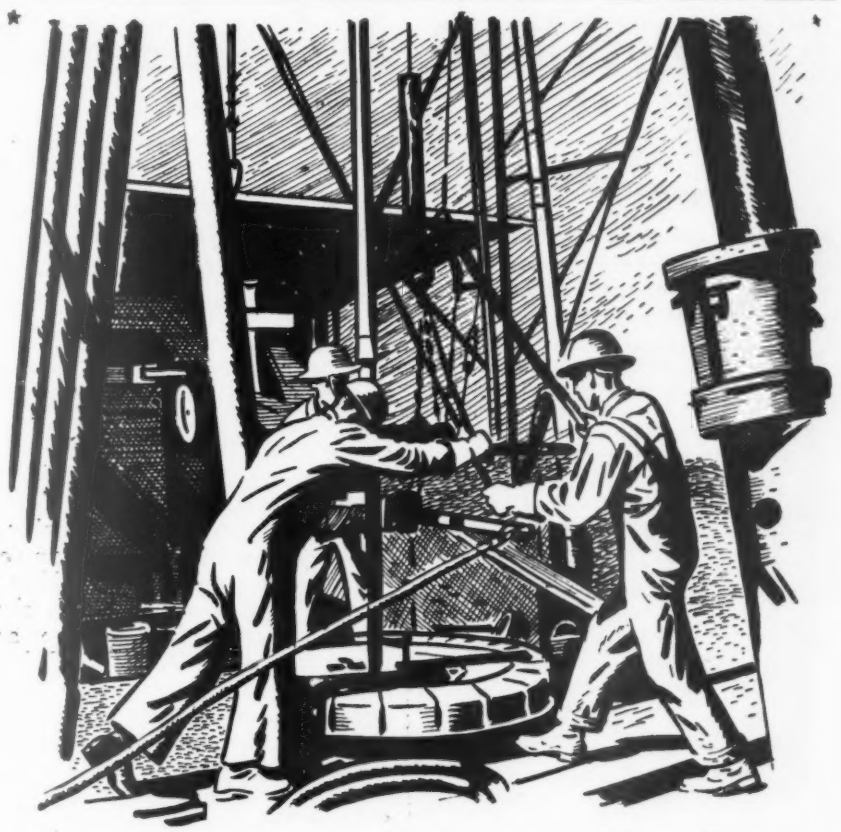
Engineers' Code of Ethics

The Engineers' Council for Professional Development has adopted a "Canons of Ethics for Engineers," especially to serve as a moral guide to young engineers as they progressively assume professional responsibility.

The Canons have been attractively printed on a 9½ by 14 in. card for framing and in the standard 8½ by 11 in. size for general distribution. Copies may be obtained for 50 and 10 cents each, respectively, through the ECPD, 29 West 39th St., New York 18, New York.

Bond Sale

Shell Caribbean Petroleum Company of New Jersey, a Royal Dutch Shell group company, announced that it has signed contracts for the sale at par to a group of American and Canadian insurance companies of an issue of $250,000,000 principal amount of its bonds bearing interest at 4 per cent and maturing in 1968. The bonds to be issued will constitute the only funded debt of Shell Caribbean. Proceeds of the bonds will be used for oil development in the Western Hemisphere.



Balancing Today's Needs

A practical working knowledge of the oil industry—combined with ample resources and helpful facilities—have made Republic the choice for oil financing.

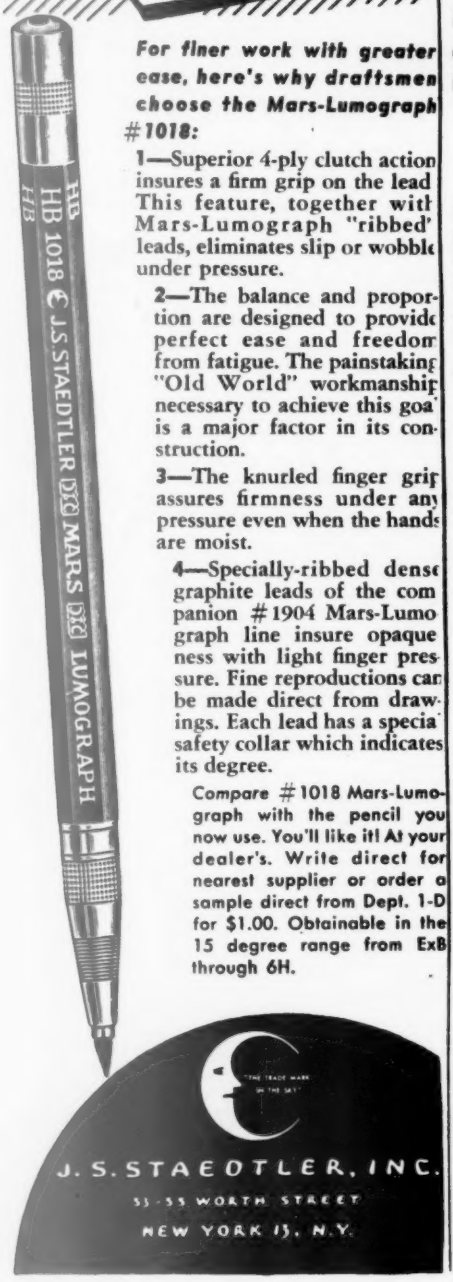
CAPITAL AND SURPLUS — $25,000,000

. . . . Largest in the South

REPUBLIC NATIONAL BANK
of DALLAS

MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION

THE *Mars* LUMOGRAPH ARTIST PENCIL HAS EVERYTHING



For finer work with greater ease, here's why draftsmen choose the Mars-Lumograph #1018:

1—Superior 4-ply clutch action insures a firm grip on the lead This feature, together with Mars-Lumograph "ribbed" leads, eliminates slip or wobble under pressure.

2—The balance and proportion are designed to provide perfect ease and freedom from fatigue. The painstaking "Old World" workmanship necessary to achieve this goal is a major factor in its construction.

3—The knurled finger grip assures firmness under any pressure even when the hands are moist.

4—Specially-ribbed dense graphite leads of the companion #1904 Mars-Lumograph line insure opaqueness with light finger pressure. Fine reproductions can be made direct from drawings. Each lead has a special safety collar which indicates its degree.

Compare #1018 Mars-Lumograph with the pencil you now use. You'll like it! At your dealer's. Write direct for nearest supplier or order a sample direct from Dept. 1-D for $1.00. Obtainable in the 15 degree range from ExB through 6H.

J. S. STAEDTLER, INC.
55-55 WORTH STREET
NEW YORK 13, N.Y.

Bailly Addresses Nomads on Venezuela

Guests from foreign fields at Los Angeles Nomads meeting, October 13, at Jonathan Club, included those above. Seated are Florent H. Bailly, guest speaker; Gilberto Carriles, consul of Venezuela; T. C. B. Vandenberg, American Overseas Petroleum Company; O. M. Hulsey, Shell Oil Company. Standing are C. D. Hendershott, Bahrein Petroleum Company, Ltd.; B. R. Wall, Iraq Petroleum Company; Roy J. Tribbey, Jr., Socony-Vacuum Oil Company; G. H. Atkins, Creole Petroleum Corporation, and J. R. Gregath, Western Gulf Oil Corporation.

A large representation of members and friends turned out at the regular meeting of Los Angeles Nomads on October 13, 1948, at the Jonathan Club, to hear Florent Bailly in another of his illuminating talks on Venezuela. Born in Caracas, Bailly is thoroughly familiar with every aspect of life in this interesting republic; is especially informed on oil developments, present and prospective, and has a fine command of English to make more lucid the telling of his story. As usual his presentation precipitated a lively discussion, and was obviously thoroughly enjoyed. Honored on the same occasion was Senor Gilberto Carriles, Venezuelan consul, and a number of other distinguished visitors from foreign fields, including T. C. B. Vandenberg, American Overseas Petroleum Company; O. M. Hulsey, Shell Oil Company; C. D. Hendershott, Bahrein Petroleum Company, Ltd.; B. R. Wall, Iraq Petroleum Company; Roy J. Tribbey, Jr., Socony-Vacuum Oil Company; G. H. Atkins, Creole; James R. Gregath, Western Gulf Oil.

In the absence of Fred Ripley and Lee Laird, Earl Boggess presided over the meeting, and did a very neat job. Considerable time was devoted to settling the details of a western party to be held later in the month, and the following new members were voted into the organization: Regular: L. A. Calhoun, McCullough Tool Company; Ray W. Elliott, Elliott Manufacturing Company; W. A. Thompson, Jr., Petroleum Maintenance Company. Associate: Ben W. Brundage, Hamer Oil Tools, and R. J. Eiche Associates; Robert W. Shira, Patterson Ballagh Division of Byron-Jackson Company; Don O. Hanson, Oil and Gas Journal.

G-E Research Grants

Applications are now being accepted for research grants under the $1,000,000 General Electric Education Fund for the scholastic year of 1949-1950, William W. Trench, company secretary and chairman of the G-E Education Committee, announced.

For the 25th consecutive year, aid in grants up to $1,500 annually will be awarded to college graduates who wish to continue individual study and research in scientific and industrial fields, Trench said.

Applications for the fellowships, which must be filed by January 1, 1949, have been distributed. They must be mailed to the Secretary, General Electric Company Education Fund, Schenectady, New York.

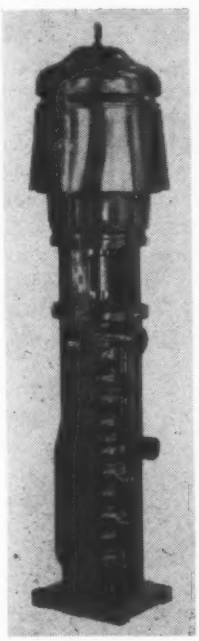
Subsidiary for Buda

The Buda Company, Harvey, Illinois, has acquired the W. F. Hebard and Company, Chicago, Illinois, manufacturers of materials handling equipment including "Shop Mule" tractors and lift trucks. W. F. Hebard and Company will be operated as a wholly owned subsidiary of The Buda Company. The present line of products will be continued.

new and improved machinery and equipment

A REGULAR FEATURE
appearing in
THE *Petroleum* Engineer
Irwin-Keasler Building
Dallas 1, Texas

(1) Hydroplex Pump



The Pump Division of the Byron Jackson Company has widened the application of its centrifugal pump design to include the vertical, hydroplex pump for high pressure, low volume pumping. A less expensive and smaller version of the Hydropress line of pumps, the Hydroplex pumps are suitable to die casting, water pressure boosters, and refinery service. The Hydroplex pumps have inherent hydraulic balance. Radial and axial forces are balanced out over the load range. Radial forces are balanced out by the staggered volute construction. The outlet of each stage is diametrically opposite the outlet of adjacent stages. This reduces the pressure bending moment of the shaft and the possibility of extreme shaft deflection. Balance of axial thrust forces is achieved by opposed grouping of impellers.

Standard sizes are 1½x2x5½ and 2x2½x6. Capacities range from 10 to 140 gpm. Heads range from 450 to 1700 ft. Temperature limit is 300 F. Standard drive is a direct-connected 3-phase, 50 or 60-cycle, 220/440-volt 2-pole, vertical electric motor. Operating speed is 3550 rpm (60 cycle) or 2950 (50 cycle). Special pumps and motors can be engineered to higher rotating speeds or greater capacities.

(2) Bit Weight Control

A new electrical system that automatically controls the weight of an oil-well drilling bit hundreds of feet below the surface of the ground has been announced by General Electric's Materials Industries Division.

Available six months subsequent to receipt of order at the factory, the new G-E automatic bit-weight control consists of four components—a drag generator, an amplidyne-controlled regulating generator and exciter, a main control panel, and an operator's control panel. It can be applied to any kind of rotary drilling operation, electrical, mechanical, or steam.

The system automatically holds a pre-selected bit weight, independently of drilling speed, thereby assuring a uniformity of weight on the bit impossible with mechanical braking. A "drag generator" applies the electrical hold-back torque to the drawworks drum, and an amplidyne-controlled regulating generator keeps this torque constant over the selected range of drilling speeds.

This control device is expected to speed up drilling operations by minimizing the number of times the entire drillstem must be brought to the surface to replace wornout drilling bits. By controlling tension on the drill stem, the bit-weight control eliminates excessive wear on the drill's sharp cutting edges and bearings.

Simple to install, the bit-weight

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P. O. Box 1589, Dallas, Texas

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
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NAME..... TITLE.....

COMPANY NAME.....

STREET ADDRESS.....

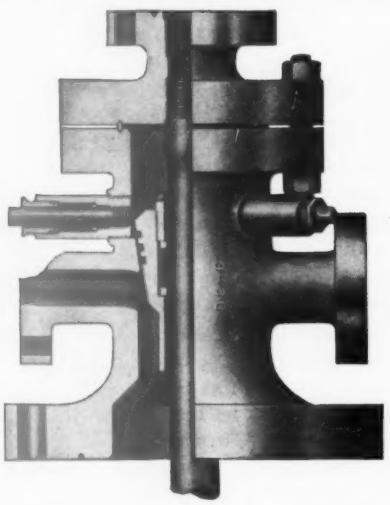
CITY..... ZONE NO..... STATE.....

control system requires no additional power source; the same engine that drives the rig, belt-drives the regulating generator. The connecting power cables are equipped with coupler plugs and sockets.

(3) Tubinghead

The DC-6 tubinghead, developed and manufactured by The Brewster Company, is specifically designed for use in dual completion wells, or in wells where a packer is set. However, the DC-6 tubinghead may be used on any well where absolute pressure protection is desired.

A positive pressure control system is provided by means of four locking



screws set in the barrel of the tubinghead, which engage a mandrel type seal to afford complete protection for the well after completion.

While tubing is run, or well is being completed, pressure control is provided by a blowout preventer. If desired, the mandrel seal may be easily made up and landed through the blowout preventer. The four locking screws are screwed in, and their tapered heads engage the shoulder of the mandrel, as shown in the illustration.

The Brewster DC-6 tubinghead features simple design and ease of installation. Designed for mounting on API flanged casingheads, the DC-6 has a full opening so that the well may be serviced when necessary. High pressure "V" type packing is used in mandrel seal and locking screws.

The DC-6 tubinghead is made in 6000 and 10,000 psi tests. Other tubingheads are produced by Brewster in tests from 2000 to 10,000 psi.

(4) Turning Rolls

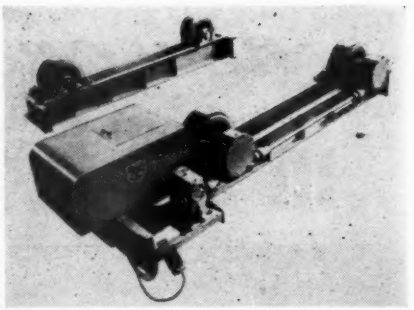
A new, improved line of turning rolls, designed to increase welding production, has been announced by Ransome Machinery Company, a subsidiary of Worthington Pump and Machinery Corporation. Capable of carrying heavier loads with less handling and giving longer, trouble-free operation, the new line helps produce neater, better, quicker welds by allowing all welds to be made in the downhand position, it is stated.

Several added features enable the 1948 Ransome turning rolls to facilitate the welding of tanks, drums, pipes, and pressure and cylindrical vessels of all types. Of special note are the antifriction, self-aligning bearings in both the power and idler rolls of the larger sizes; a lowered drive mechanism, which permits unobstructed loading from either end, and an exclusive, combination steel and bronze worm wheel.

The bronze worm wheel, a critical part of the drive mechanism, has been reinforced against stresses resulting from heavy loads by the addition of a steel hub and center to which the bronze rim is firmly bolted.

Operation of the rollers is simplicity itself. The vessel has merely to be placed on the rollers and rotated around to the welder or automatic welding head at the desired welding speed.

Self-propelled turning rolls on four-wheel carriages are also available. The self-propelled turning rolls make possible the automatic welding of all circular, as well as longitudinal seams,



both inside and outside, with the automatic welding head remaining in one fixed position. This eliminates all vibration at the welding head itself and insures a good continuous weld.

(5) Tubing Elevator

Regan Forge and Engineering Company is now making a tubing elevator with a double safety feature. Even when the door is not locked, a positive acting safety latch that rotates with the lock keeps the tubing locked within the elevator, thus the tubing can never drop even though door is open. The regular door lock has double looking faces. The body of the elevator is a heat-treated, solid alloy steel casting that is designed with a four-to-one safety factor. Produced under the name of the Regan Dualock Tubing Elevator, the patented double safety features were thoroughly pre-tested.

(6) Fire Truck

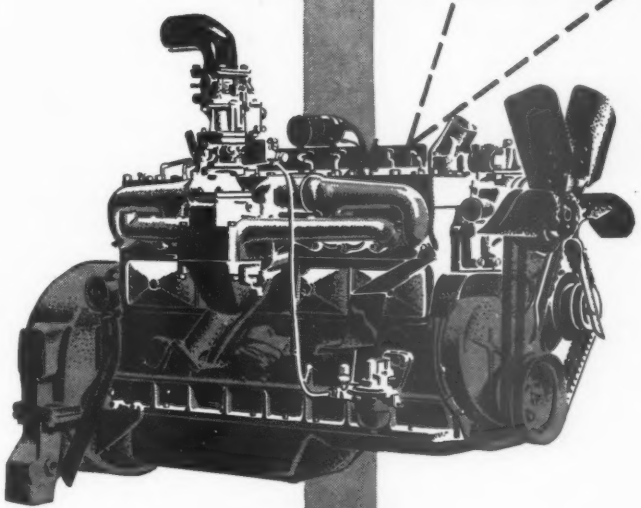
An entirely new type of fire truck has been designed and manufactured by the Fire Extinguisher Division, Ansul Chemical Company, it is announced. This fire truck, the first to use dry chemical as the primary extinguishing agent, provides maximum protection for airports, oil refineries, chemical plants, and other installations where severe flammable liquid fire hazards exist, it is said.

Twenty-eight hundred pounds of dry chemical and 250 gal of water are carried on the truck. Fully loaded, the vehicle weighs 21,500 lb. It is 95¾ in. wide and 21 ft 6 in. long. Cab height is 8 ft, turret height 10 ft 6 in.

Ansul's new fire truck has four-wheel drive, five forward speeds and one reverse. Maximum governed speed is 62 mph, although the governor can be removed if greater speed is desired. Four extra compartments on the sides of the truck house accessory fire and rescue equipment.

FOR A BETTER DAY'S WORK

in harvesting the world over



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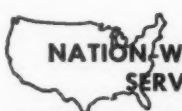

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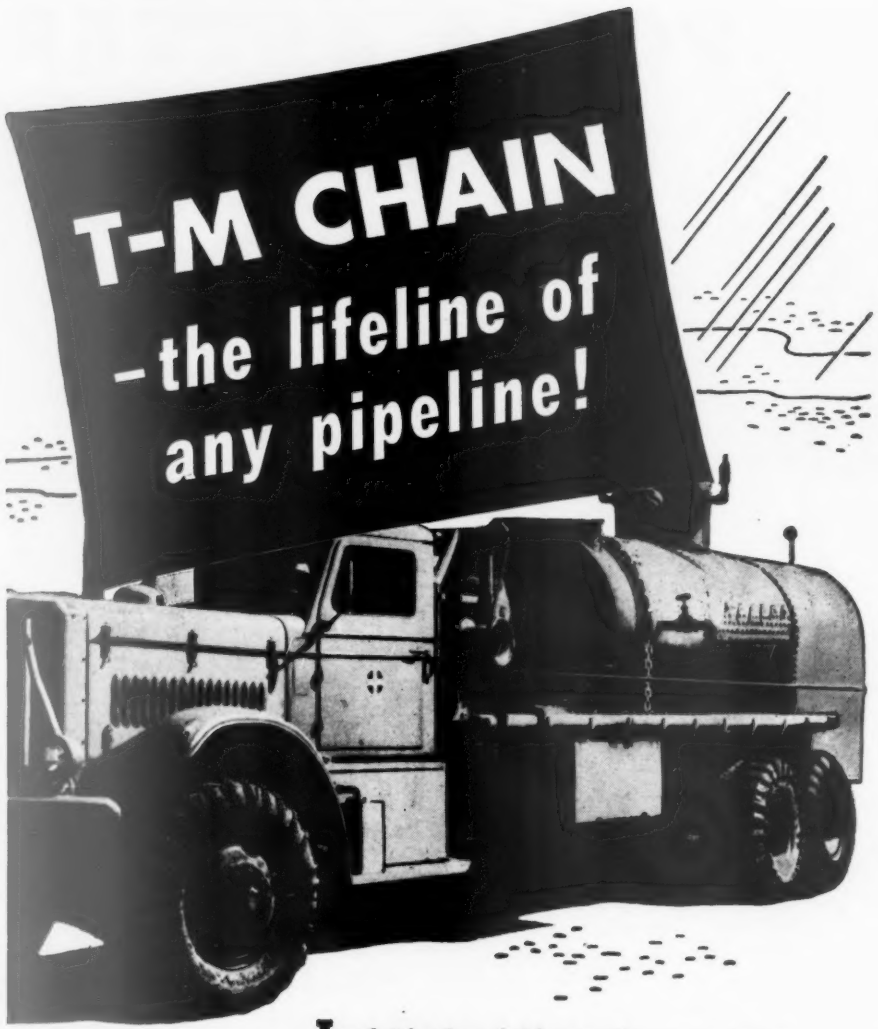


IN field after field petroleum men are switching to TM Chain for its safety... for its trouble free dependability... for its long life and economy. Yes, they have learned that TM Chain is the life line of any pipe line. They have learned that TM Tire Chains help carry supplies in spite of mud, snow or ice—they have learned that TM Hi Test Chain helps to keep rigs going under the most grueling conditions.

The reasons are as simple as one, two, three—Taylor has been making chain for seventy-five years; the men who fabricate TM Chain have been at it most of their lives; the materials they use are made to Taylor's tried and proved formula.

There's a TM Chain jobber near you. Contact him or write direct. S. G. TAYLOR CHAIN COMPANY, 102 141st Street, Hammond, Indiana.

TAYLOR MADE Chain

"THE BEST BY TEST SINCE 1873."

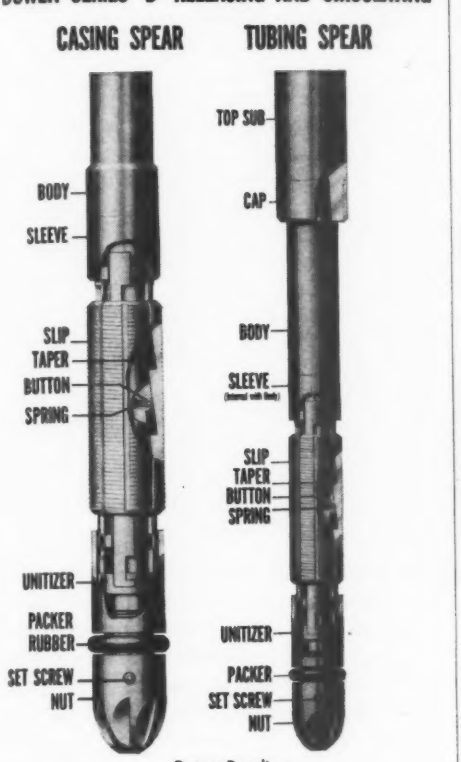
(7) Filter Trap

Haskell Green, president of the Filter Trap Company, announces the introduction of a new Agate filter trap that is said to have shown excellent results in extensive California field tests. The new trap, designed to reduce pump wear, gas-locking, surging, and emulsification, contains some 6000 tempered agate balls, which at each stroke of the pump are set in motion. Thus, the section in which they are located becomes in effect a ball mill, where fine sand and small particles of shale that adhere to them are separated by grinding action. Sand remains in the trap and a clean flow of fluid is released to the pump, cutting pump wear to a minimum, and reducing the number of pulling jobs markedly, it is stated. The steady release of gas through the agate medium and thence through the gas chamber prevents surging and gas-locking, with a consequent control of shock to pumping and other equipment, and a corresponding reduction in shut-down time. The grinding action of the agates, also, in many cases, breaks down emulsions, simplifying subsequent dehydration and so further reducing operating costs. For a small service charge, the filter trap will be exchanged while the well or pump is being pulled.

(8) Fishing Tool

The Series "D" Bowen releasing and circulating spears are a departure from conventional spear designs, according to the manufacturer, S. R. Bowen Company. The spears utilize full circle slips that contact virtually the entire surface of a long section of the fish and in addition the entire inner circumferences of the full circle slips are backed by tapers on the spear body. Consequently, when a fish is engaged and upward pull is exerted the expansion strain is spread so evenly over so much of the inner surface of the fish that there is no fish distortion. By overcoming the problem of fish distortion the spears insure the operator that there will be no loss of engagement regardless of the degree of the upward pull and regardless of the intensity of the jarring blows, it is pointed out. In tests with hydraulic jacks and on trial runs in conjunction with jars, pipe has been pulled and

BOWEN SERIES "D" RELEASING AND CIRCULATING



Patent Pending

jarred in two below the Bowen spear with no distortion of the fish at the point of engagement.

As their primary releasing mechanism, Series "D" spears provide means for hanging and supporting the full circle slips in their uppermost position relative to the spear body. When in this position the full circle slips cannot be expanded against the fish by the tapers on the spear body and the spear can be easily withdrawn from the fish. As a secondary releasing mechanism, left hand wickers are cut on the full circle slips to permit unscrewing from the fish. The spears can be engaged with and released from a fish indefinitely without being withdrawn from the hole.

Series "D" spears are equipped with integral pack-off rubbers to provide the ability to circulate through the fish. These features eliminate the need for accessory equipment and they do not interfere with the spear's operation when they are not required. Spears in drill pipe and tubing sizes are provided with skirt threads for installation of skirts and oversize guides when such accessories are necessary to insure alignment of the spear with the fish. All full circle slips are of the all-purpose type having horizontal wickers for pulling and vertical wickers for right handing or left handing a fish.

(9) Chemical Gage

Helicoid Gage Division, American Chain and Cable Company, Inc., announces a new chemical gage particu-

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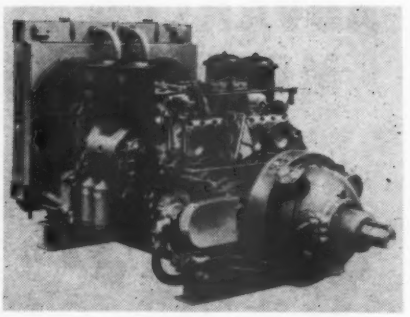
larly suitable for chemicals and other viscous liquids that either corrode or clog the Bourdon tube of a standard pressure gage. One feature of this new chemical gage is that the diaphragm is made of Teflon, which satisfactorily resists practically all corrosive chemicals. The use of a Teflon diaphragm instead of metal makes it possible to supply this gage for vacuum and for compound ranges as well as for pressures as high as 1600 psi and for temperatures at the gage of 300 F.

The removable bottom part and diaphragm ring are supplied in cast iron, bronze, steel, stainless steel, hastelloy, lead coated iron, and monel.

(10) Power Plant

A major advance in the development of oil field power plants has been unveiled by the Detroit Diesel Engine Division with the announcement of a torque converter and fluid coupling unit specifically engineered to the General Motors Series 71 2-cycle diesel engine. In making known this latest product of General Motors engineering skill, Detroit Diesel becomes the first producer to make available a complete engine and torque converter combination power unit of one manufacture, it is stated.

Consisting of four major elements



—a pump, turbine, and two stators—the unit produces torque multiplication of up to 4 to 1.

Consistent with the General Motors idea of producing powerful oil field diesel engines of small size and light weight that can be easily transported, the General Motors Diesel engine-torque converter unit has been designed into an extremely compact package. The complete integrated power plant actually occupies no more space than the same engine equipped with the conventional clutch and power take-off, it is asserted. This accomplishment has been made possible by employing the flywheel as a working component of the torque converter assembly.

The unit combines the features and advantages of both torque converters and fluid couplings, it is said. Outstanding characteristic is its ability to pick up load with maximum lifting power and shift automatically from torque converter to fluid coupling principle in the higher speed range. High torque is available for such operations as coming out of the hole while a highly efficient transmission of power is provided for continuous load assignments. This high efficiency of the General Motors torque converter is maintained through a wide speed range making it suitable for either drawworks or mud pump applications.

The new engine-torque converter combination is made available by Detroit Diesel in the Single 3, Single 4, Single 6, Twin 4, and Twin 6 Series 71 models having engine ratings ranging from 75 to 300 hp.

(11) New Truck Series

Marmon-Herrington Company, Inc., has announced a new line of heavy-duty All-Wheel-Drive converted Ford trucks, identified as the "Q" Series. There are six models in the new Marmon-Herrington "Q" Series. Three models are 4-wheel-drive, three models 6-wheel-drive. Gross vehicle weight for 4-wheel-drive models is 21,500 lb, for 6-wheel-drive models 35,000 lb. Wheelbases range from 136½ in. to 220 in.

In building the "Q" Series, Mar-

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The twin nuisances of Diesel engine operation—intake and exhaust noise—can easily be turned into "quiet twins." Plan to install Burgess-Manning Matched Intake and Exhaust Snubbers on your present or projected Diesel power plant.
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mon-Herrington starts with standard Ford F-7 models. Recently introduced Ford F-7 models are much bigger in all respects than any previous Ford trucks. With normal gross vehicle weight of 19,000 lb, they are, in fact, the first true heavy-duty trucks ever built by Ford. All F-7 models are powered by Ford's 145-hp V-8 engine.

Marmon - Herrington All - Wheel-Drive trucks of this new series are especially engineered and powered for types of heavy-duty service that have proved either too difficult or altogether impossible for trucks of conventional drive. With live power and traction in all wheels—front wheels pulling, rear wheels pushing — they have the tremendous tractive power needed to transport peak loads through deepest mud, sand or snow, up steepest hills and mountain grades. They are particularly suited to a wide variety of off-the-road services — oil field and pipeline work, mining and logging operations, telephone and power-line construction and maintenance, etc.

In addition to the six "Q" Series models, the Marmon-Herrington line of All-Wheel-Drive trucks includes 12 other Ford conversions and four heavy-duty models of its own manufacture. In all, there are 22 models, with gross vehicle weights ranging from 42,000 to 47,000 lb. Altogether, there are five engines—three 6-cylinder and two V-type 8-cylinder. These vary from 95 hp to 145 hp.

(12) F-M Carrier Telegraph

Immunity from interference by crossfire, earth currents, lightning, static, and weather change is the chief objective in a newly-designed f-m or carrier-shift telegraph system announced as type 22 by Lenkurt Electric Company. Interference-free operation is possible with eighteen 60-word-per-minute channels between 420 and 2460 cps or twelve 75-wpm channels between 425 and 2039 cps.

Negligible bias distortion is introduced by received-level variations between plus 6 and minus 40 dbm. This contributes to optimum operating margin and range. Sending level is adjustable from minus 40 to zero dbm. To achieve the best possible filter sharpness the designers have utilized multisection networks incorporating toroidal coils wound on molded iron-powder cores, all produced by the same manufacturer.

Physically the units are constructed of aluminum for lightness and ease of handling. Transmitters, receivers, and relays are mounted in separate panels for installation flexibility. This permits mounting all relays together for convenience of maintenance or setting up one-way circuits where traffic may be heavier in one direction.

For utmost serviceability, silvermica and oil-filled capacitors are used. All components are derated, plug-in relays are used throughout, and circuits are designed to use industrial-type electron tubes.

(13) Pressure Cells

Three new SR-4 *Fluid Pressure Cells, extending the available ranges down to 0 to 200 psi, one-tenth of the previous minimum range, are announced by The Baldwin Locomotive Works. Higher accuracy within each range is the principal advantage gained, the manufacturer asserts. Calibration accuracy of all cells at any pressure is within plus or minus ¼ per cent of full range.

Other new ranges are 0 to 500 and 0 to 1000 psi. The three additions increase available ranges to eight: 0 to 200, 500, 1000, 2000, 5000, 10,000, 20,000 and 50,000 psi.

Baldwin SR-4 Fluid Pressure Cells can be used in any gas or liquid pressure system by screwing into a tapped hole opening into the system, thus giving the gas or liquid access only to a

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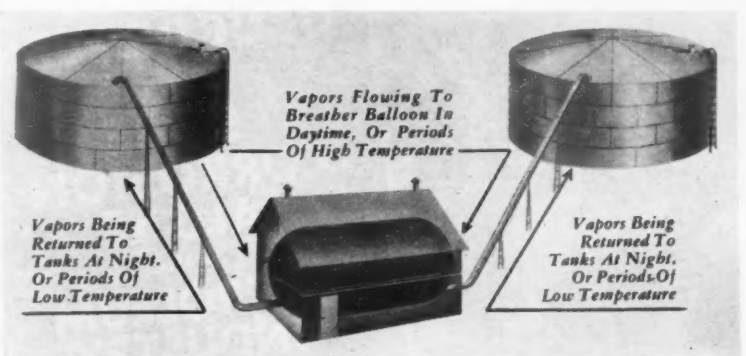
The world-wide petroleum shortage, together with mounting production costs, makes it imperative for the industry to adopt improved conservation programs. The estimated annual loss through evaporation alone is too great a loss to afford.

A prime cause of evaporation losses is BREATHING LOSSES in storage tanks—particularly in tanks which are more or less static, and where high throughputs are not encountered.

HOW THE BREATHER BALLOON WORKS TO CONSERVE VAPORS

The VULCAN Breather Balloon is a collapsible and expansible balloon of special coated fabric, of high resistance to gasoline vapor diffusion. It is connected with the storage tank singly or in series. The following diagram illustrates its simple but important function:


Vapors Flowing To Breather Balloon In Daytime, Or Periods Of High Temperature
Vapors Being Returned To Tanks At Night, Or Periods Of Low Temperature
Vapors Being Returned To Tanks At Night, Or Periods Of Low Temperature

The VULCAN Breather Balloon is fabricated in various sizes and shapes—tailor-made to the application, in capacities of 1,000 to 25,000 cubic feet. It is simple, flexible and economical to install. It helps reduce fire hazards. Shipping and maintenance costs are negligible.

For detailed information about how to reduce vapor losses, **at low cost, write for illustrated literature.**

Vulcan
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sealed tube in the cell. SR-4 resistance wire strain gages, bonded to the outside wall of this tube, are stretched when pressure expands the tube, thus increasing their electrical resistance. This change of resistance may be measured electrically by an indicator or recorder at considerable distance, or it may be used to trip a relay or actuate a control device. The cell has no mechanical moving parts. It is especially valuable where long distance indicating is required since impulses are transmitted electrically. Only a 4-volt supply is required.

*Trade Mark Registered, U. S. Patent Office.

(14) Underground Boring

For horizontal boring underground Howell Utility Tool Company has a new type rotary tool that is being used by pipe line companies, oil refineries, and city utility companies, among others. The equipment makes it possible to install lines and conduits with a minimum of trenching and a minimum of labor, it is asserted. The equipment can be operated by one man. Features enumerated are as follows:

Long bores possible; few rebores necessary; easy to insert pipe after boring.

Little power required for rotation. Smooth cutting action results in long life of tools.

No sharp corners to puncture or tear hidden underground structures.

Cutters can be quickly replaced on the job.

Cutter disks are set at proper angle to present and maintain sharp cutting edges.

(15) Pipe Straightening

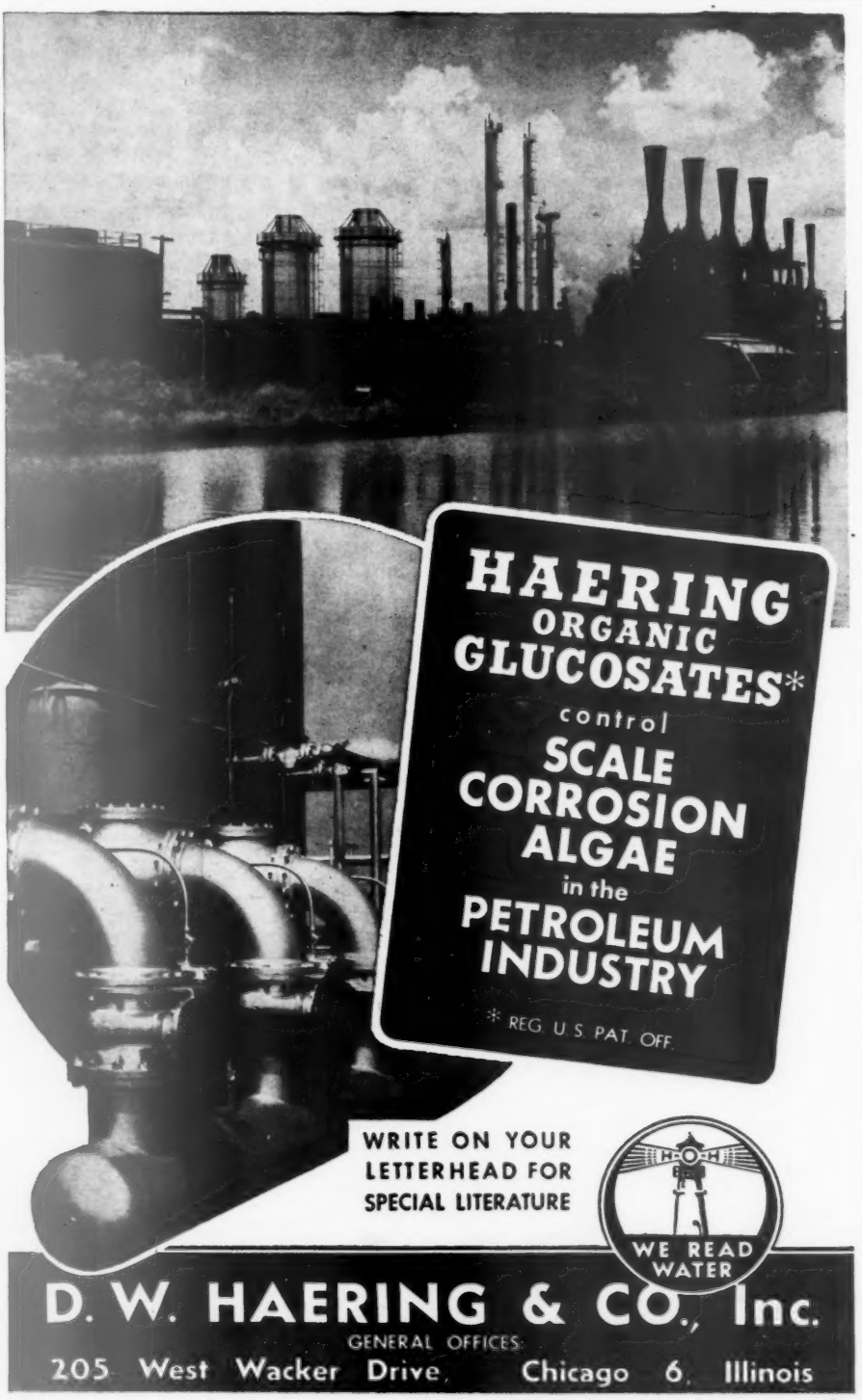
Newest product offered by the G. T. Bynum Company is the hydraulic power unit for pipe straightening machines. This unit is designed to speed up the pipe straightening operation by eliminating hand pumping. Requiring only one connection for installation, the hydraulic power unit incorporates many safety devices and all moving parts are away from the operator. Models are available now from 2000 to 6000 psi. This unit can also be used to power hydraulic presses or other hydraulic equipment.

(16) Core Gas Analyzer

Petroleum Instrument Company has announced an improved instrument for detecting and measuring hydrocarbon gases contained in core samples and cuttings. Designated as the Model "B" core gas analyzer, the manufacturer asserts that the unit enables the operator to detect and determine, immediately upon taking a core from the well, the pressure and the relative volume of gas present in the formation. Coring procedure and drillstem test points can be decided right at the rig without delays for laboratory analysis.

The core, or sample of the cuttings from the well, is crushed hydraulically under pressure from 6000 and 10,000 psi, thereby collapsing all pore space within the core and releasing any gas present. The gases are withdrawn from the crusher chamber through a vacuum system and flow into the instrument for measurement.

Should the sample contain only a



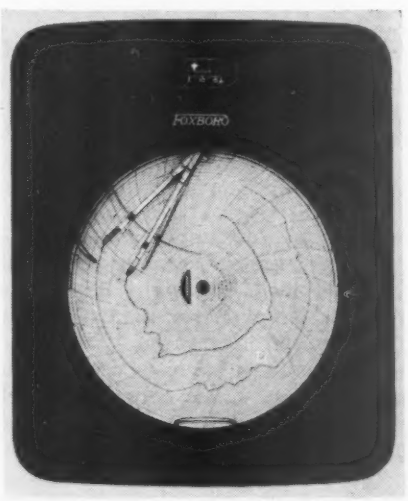
very minute amount of gas, it would nevertheless, be indicated and measured. Although the amount of gas is so small that it will not openly burn, it is sufficient to create a thermal combustion effect across the sensitive platinum element that is used as a catalyst, thus effecting an electrical bridge circuit. Readings are taken direct from the gas volume meter. No complicated computations or formula required. Electrical current is provided by dry cell batteries contained in the unit.

The instrument is light-weight, easily portable, and ruggedly constructed for field service.

(17) Auto Selector

With the announcement of its Auto-Selector Controller, an important addition is made to the line of industrial control instruments offered by The Foxboro Company. This new instrument controls, selectively, from either of two related variables, by positioning a single valve, damper, or other operator. This selection is determined by the variable having the greater tendency to exceed its pre-set limit; and the transfer of control is made smoothly, instantly, and automatically.

The Auto-Selector not only does the work that previously required two controllers, but has an added important advantage in that it may incorporate the automatic reset function in the control of either or both variables. The design of the instrument embodies two measuring systems and two interconnected Foxboro Model 40 control mechanisms. Control action of both mechanisms may be on-off, proportional, proportional with derivative, proportional with reset (Stabilog), proportional with reset and derivative (Hyper-Reset), or any combination of these.



A typical application of the Auto-Selector Controller is in a pipe line pumping station, where it controls either the discharge pressure or the suction pressure of the pump, in accordance with supply and demand requirements. Other examples include the control of brine flow through a heat exchanger, to maintain the temperature of the cooled material at a pre-set value, as long as outlet brine temperature is above a pre-set minimum; also, the control of fuel supply to operate an oven at a desired temperature, while keeping the heater temperature below a safe limit. It is not necessary that the controlling measurements be of like variables. Any two that are related may be combined, such as outlet temperature and steam pressure in a heat-exchanger, or temperature and flow of brine in a cooler.

The Auto-Selector Controller is available as a recorder or indicator.

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(18) Testing Motor Fuels

Phillips Petroleum Company, Chemical Products Department, has issued Bulletin 257, which gives operating and maintenance instructions on the Model 501 Detonation Meter and the Model 125 Signal Generator. The Detonation Meter is used to test motor fuels in internal-combustion engines. After a study of many years duration on the general problem of detonation detection in engines, the Detonation Meter, Model 501, was designed to duplicate bouncing pin ratings obtained with the Motor and Research Test Methods. According to Phillips, the Detonation Meter has been found comparable or superior to the bouncing pin with respect to stability, sensitivity to small differences in fuel quality, rating reproducibility, and positive response to changes in knock intensity, and, in addition, the instrument is simple from an electrical viewpoint, is rugged in construction, and in routine use down time due to failure in operation of the meter has been found to be small.

The Model 125 Signal Generator is an electronic instrument for checking and adjusting the Model 501 Detonation Meter within particularly close limits.

(19) Pipe Line Cleaning Tools

In recent years pipe lines of all types have been increased in length, size, and operating pressures. To meet these exacting conditions T. D. Williamson, Inc., has created pipe line cleaning tools and specialties designed to meet the construction and operating conditions peculiar to each specific pipe line. A brochure has been prepared by the company in which is shown the diversity of applications for which the cleaning tools are designed, and the useful applications for other pipe line specialties manufactured by Williamson. Equipment presented in the brochure includes "pigs" of various types, casing bushing, casing insulator, tapping machine, and expansion plugs.

(20) Electronik Potentiometers

The Brown Instrument Company, division of Minneapolis-Honeywell Regulator Company, has issued a new catalog, No. 15-13, on ElectroniK potentiometers. Schematic diagrams, photographs, and dimensional drawings are used to illustrate the constructional features and operating principles of the instruments presented. Among the instruments and systems included in the catalog are the ElectroniK strip chart electric control potentiometers, strip chart and circular chart recorders, precision indicators, strip chart and circular chart controllers, indicating controllers, pyrometric switches, thermocouple and radiamatic assemblies, and the "continuous balance" principle.

Another feature of this new Brown catalog is the presentation of illustrative tables of various control forms, typical control systems, style selection tables, and other data that will be helpful in the selection of proper instrumentation.

(21) "Renewo" Valve Threesome

An illustrated 12-page folder No. 577, introducing the Lunkenheimer "Renewo" Valve Threesome is now available from The Lunkenheimer Company. This new literature illustrates in cutaway fashion the interchangeability of parts by which users of regular type "Renewo" valves can convert to either nickel alloy or stainless steel plug type valves by simply changing seats and disks.

The renewable features of this new valve line reduce original and maintenance expense by lowering stock room investment, simplifying ordering and handling, and facilitating repairs. The complete line is featured in Globe and Angle types, rated at 200 and 300 psi steam pressure. The "NS5" nickel alloy seats and disks have a hardness of 330 Brinell and the stainless steel a hardness of 500 Brinell. Helpful tables of dimensions are also included.

(22) Crank Shapers

A new 24-page catalog in three colors, carrying illustrations and complete description of the Gemco line of multipurpose crank shapers, is off the press. The catalog treats each feature of engineering—tool head, ram, crossrail, column, base, transmission, bull gear assembly, rocket arm, "Lubrigard" and lubrication system, unilateral table control, rapid traverse, feed mechanism, stroke adjustment, centralized controls, accessories—separately by illustration and description for clarity and understanding. A table of complete specifications on each Gemco shaper is a feature of the new catalog.

(23) Oil Industry Paints

For a number of years chemists and technicians of the Pratt Paint and Varnish Company have made a scientific study of painting problems confronting the oil industry. The result has been the production of a special group of products to provide the industry with maximum protection. In a catalog just issued this line is fully described.

(24) Water Content of Oil

An interesting pamphlet has been released by the Oil Well Water Locating Company, describing the Enniscope, a continuously recording instrument for determining the water content of oil at any point in the gathering system, from the wellhead to the refinery. The modus of operation is clearly defined and diagrams of common installations are included. The device is based on an electronic principle that is capable of application to production metering, and continuous water recording. It may also be utilized to function as a self-operating water bleeder on rundown or storage tanks. It is stated, in fact, to be fully automatic and accurate in all its uses, and completely overcomes the human error to which the manual types of gauging, testing, and water bleeding are normally subject.

(25) Overcoming Salt Corrosion

The part played by corrosion control in the production of salt, and in the use of brine solutions by chemical and food processors, is described in a new 20-page booklet issued by The International Nickel Company, entitled "Salt as a Corrosion Problem."

The booklet contains a minimum of ancient history. Its contents are about equally divided between a discussion of corrosion problems solved by the salt industry, and equipment for handling brine solutions in the chemical and process industries.

(26) Analytical Instruments

Consolidated Engineering Corporation, has issued a booklet entitled, "Analytical Instruments For Science And Industry," that presents in brief form a listing of its complete line of precision instruments. The book is divided into two sections covering (1) mass spectrometry and (2) dynamic measuring and recording. It defines the mass spectrometer employed, among other things, in refinery control and product research; and the isotope-ratio mass spectrometer used in biological and other species of investigation. The leak detector, eltromagnet, and electrical computer are also described in this section. Then in the latter half of the book

are specifications of recording oscillographs, oscillogram projectors, galvanometers, vibration meters, accelerometers, and other devices for measuring various and varied physical phenomena. The booklet should be of interest to research and development physicists and chemists in the petroleum industry.

(27) Hewitt Welding Hose

Simple and quick methods of installing patented "Twin-Weld" welding hose are told in new descriptive material released recently by Hewitt Rubber Division, Hewitt-Robins Incorporated. The company pamphlet explains the ease of handling, the increased safety, and the fast operation achieved with Twin-Weld hose. This hose is a "double-barreled" unit, made up of two lines of highest quality, cord-reinforced welded hose molded side by side in one complete unit, it is stated.

(28) Engineering Guidebook

A 20-page planning and engineering guidebook prepared to simplify and speed the layout of Allis-Chalmers load center unit substations has been released by the company. Dimensional and arrangement information enables industrial unit substation users to determine floor space and head room requirements as soon as the unit is specified.

Information is given on units ranging from 100 kva to 2000 kva used widely in industrial plants for distribution at 208Y/120, 240, 480, and 600 volts having both liquid-filled and dry-type transformers.

(29) Steam Driven Drawworks

Bulletin No. 358, 24 pages, gives complete illustrated descriptions of two Ideal steam driven drawworks, the 34-8½-FE and 34-10-FE, in three-shaft, four-speed, fully enclosed jackshaft types. Similarly designed, both types are heavy units of exceptionally powerful construction, incorporating many original and distinctive features that have met with field approval over a period of many years, according to the manufacturer, The National Supply Company. The new bulletin outlines features of construction and operation with profuse illustrations of details, gives complete specifications, shaft diagrams, and typical dimensional drawing for installation.

(30) Pipe and Fittings Catalog

An illustrated descriptive booklet covering National Carbon Company's "Karbate" brand pipe and fittings is now available. The booklet contains detailed engineering information on "Karbate" pipe and fittings, including comprehensive tables of the chemical and physical properties of the material. All pipe sizes and fittings are illustrated and cross-section drawings show dimensions, assemblies, joining recommendations and other details to aid design work and to facilitate ordering.

(31) Power Factor

"Power Factor and What To Do About It" is a new 20-page pocket size booklet No. 200-TEC-1077, that explains the essentials of power factor in industrial plants and gives a digest of power factor calculation, why low power factor should be corrected and how it can be done. The booklet is published by Electric Machinery Manufacturing Company.

(32) Welding Galvanized Pipe

The successful welding of galvanized pipe, procedure used for joining 18 gauge and 3/16-in. mild steel, overlaying dies for lead pipe extrusions, how a South American firm used Ampco-Trode for welding cast iron, new Ampco-Trode bare wire for submerged arc welding, Canadian ski-tow application and Ampco's new spot welders' ejector holder are covered in the October issue of *Ampco Welding News*.

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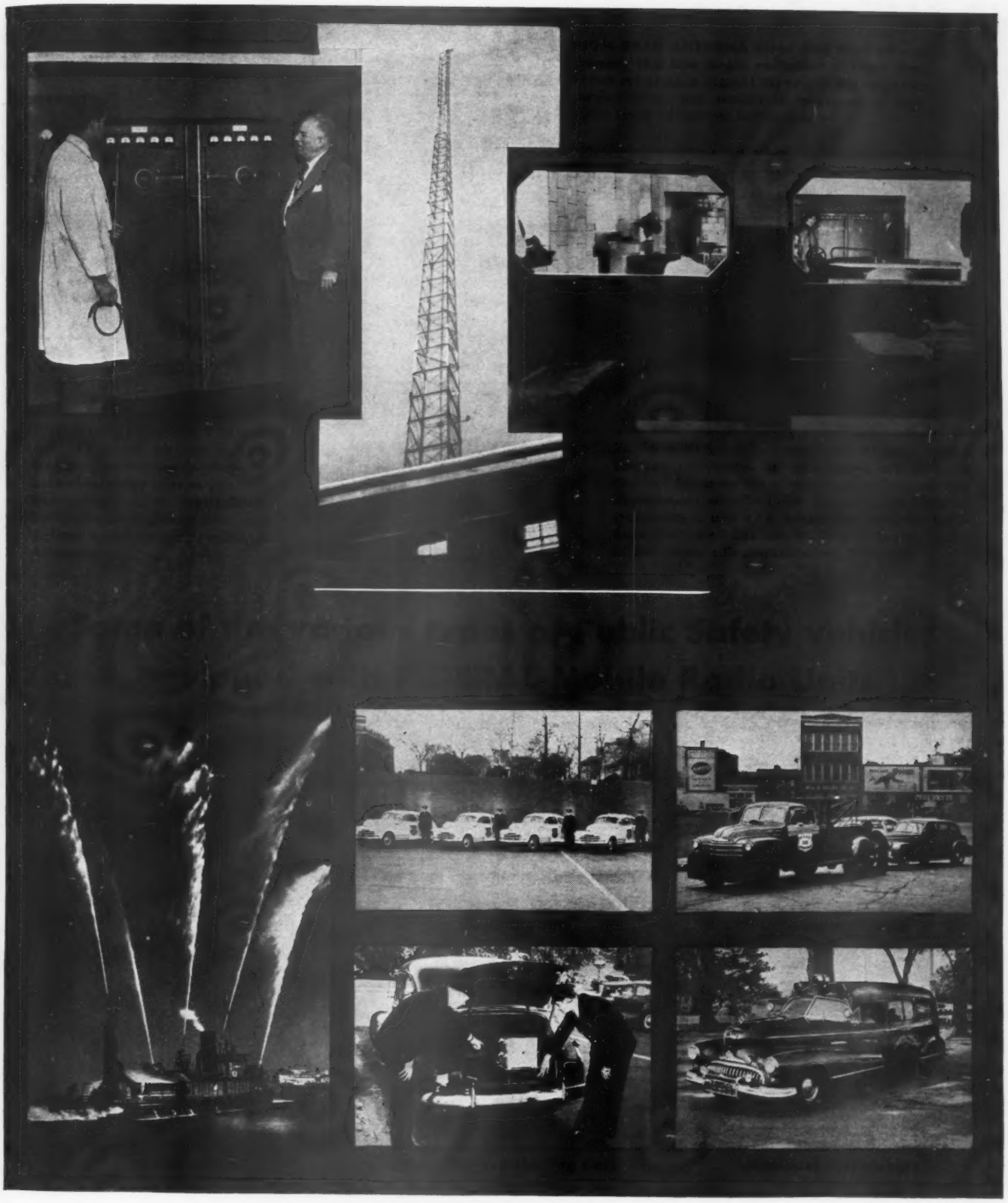

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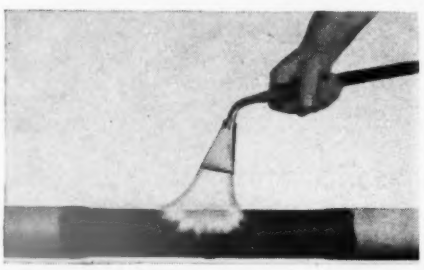
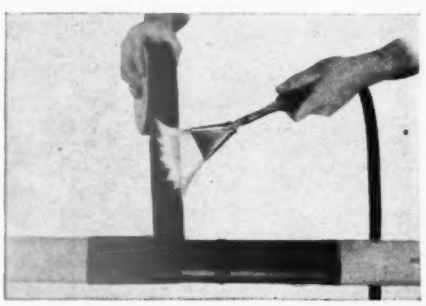


STEP 1—Remove kraft paper on mill or machine coating back far enough to start one spiral wrapping of TAPECOAT over mill coating. Clean and dry bare pipe with torch as shown.



STEP 2—Start wrapping TAPECOAT where kraft paper has been removed. Flash flame of torch *lightly* on TAPECOAT to bleed its coating. Secure double thickness of TAPECOAT by overlapping slightly more than half the width of the tape.

STEP 3—Finish wrapping TAPECOAT. When wrapping is completed, flash the torch flame over entire TAPECOATED section to bleed coating to a shiny surface.

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Foxboro moves to new building

Construction of its attractive new building being completed, the Houston Branch of The Foxboro Company, Foxboro, Massachusetts, has moved from the Sterling Building to 2518 South Boulevard, Houston 6, Texas. The company manufactures industrial instruments, control valves and similar equipment, for the measurement and control of process variables such as temperature, pressure, humidity and flow.

The new building, efficiently planned on one floor level, is on a site 13,000 sq ft in area. Conveniently located in a rapidly developing section of the city, it provides excellent facilities for the sale and servicing of Foxboro products.

The Houston Branch, opened in 1929, has had a steady growth, commensurate with the important industrial development of that area. While industries of all kinds are well represented, petroleum production and refining are outstanding in importance, especially when coupled with the distribution of natural gas and, in recent years, the phenomenal advances in the production of chemicals and other products from petroleum bases. Other Texas branches of The Foxboro Company are at Dallas and Corpus Christi. Leo W. Parten, district manager at Houston, continues in charge there, directing the corps of sales engineers who serve the large and important territory. A native of Texas, with broad experience in instrument engineering, Mr. Parten has represented Foxboro in Houston for nearly 20 years and is widely known in industrial circles in that region.

Move to new offices

C. E. Naylor, president of Maintenance Engineering Corporation, has anounced the completion of a new office building at 3711 Clinton Drive, Houston, Texas. It is air conditioned, and adjoins the old office and plant building.

The new office building contains a reception area, central switchboard, and 11 executive offices. Company executives and the engineering department moved into the new quarters.

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A valuable and regular feature of *The Petroleum Engineer*, the Continuous Tables, now in their twelfth year of publication, were designed to save time and effort for the technician and the practical field or plant worker. The tables have proved one of the most popular and helpful departments of *The Petroleum Engineer*. Data are presented in the simplest form available with many types of information included that are best presented by curves or nomographs when three or more variables must be considered simultaneously.

The Continuous Tables have been developed as a result of suggestions for new tables, direct contributions and improvements to existing tables by members of the petroleum and related industries, including manufacturing concerns, who are continually searching for practical information reduced by computation to tabular form readily applicable to the problems daily confronting them that might otherwise necessitate a more or less tedious calculation. These contributions and suggestions from the industry have resulted in a valuable exchange of information and data contributing to the progress of the industry as a whole.

This index will be revised monthly. The index for installments 1-12, inclusive, will be found in the May, 1938, issue; 13-24, inclusive, in the June, 1939, issue; 25-36, inclusive, in the June, 1940, issue; 37-48, inclusive, in the June, 1941, issue; 48-60, inclusive, in the June, 1942, issue; 61-72, inclusive, in the June, 1943, issue; 73-79, inclusive, in the January, 1944, issue; 80-82, inclusive, in the April, 1944 issue; 83-85, inclusive, in the July, 1944, issue; 86-88, inclusive, in the October, 1944, issue; 89-91, inclusive, in the January, 1945, issue; 92-94, inclusive, in the April, 1945, issue; 95-97, inclusive, in the July, 1945, issue; 98-100, inclusive, in the October, 1945, issue; 101-103, inclusive, in the January, 1946, issue; 104-106, inclusive, in the April, 1946, issue; 107-109, inclusive, in the July, 1946, issue; 110-112, inclusive, in the October, 1946, issue; 113-115, inclusive, in the January, 1947, issue; 116-118, inclusive, in the April, 1947, issue; 119-121, inclusive, in the July, 1947, issue; 122-124, inclusive, in the October, 1947, issue; 125-127, inclusive, in the January, 1948, issue; 128-130, inclusive, in the April, 1948, issue; 131-133, inclusive, in the July, 1948, issue; 134-136, inclusive, in the October, 1948, issue.

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Torrington Company		104	Nov.	P 732.4

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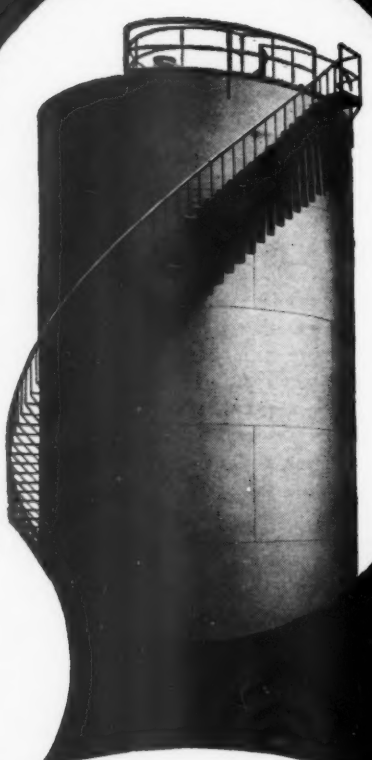

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CHARACTERISTICS OF AUTOMATIC CONTROLS IN GAS OPERATIONS

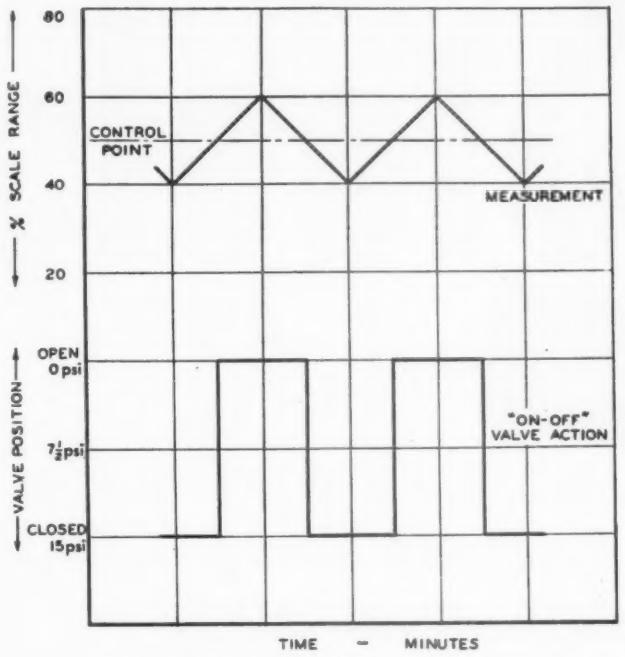

FIG. 1. "On-off" valve action diagram.

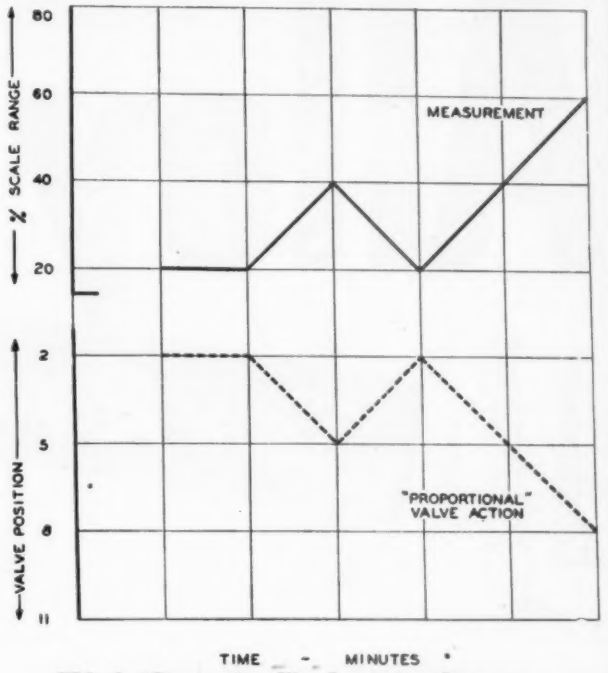

FIG. 2. "Proportional" valve action diagram.

Automatic control for the gas industry can be classified under four main types: "On-off," "floating," "proportional," and 'proportional with reset." As the floating types usually have an inherent throttling range, they can be grouped with the proportional controllers.

● **On-off control.** Fig. 1 illustrates the valve action of an on-off controller whose measurement is responding to the changes shown. It may be seen that a valve action occurs only as the measurement crosses the control point and that the valve then operates from one extreme to the other.

A proportional controller whose measurement is moving at a constant rate produces a valve action such as that shown in Fig. 2. The difference between this and the on-off controller is apparent at once as, in the latter case, the valve moves intermittently, whereas, in the present case, the valve continues to move so long as the measurement is moving, assuming that the valve does not reach the limit of its stroke. At any time the amount of valve movement is directly proportional to the amount of measurement movement, and it is in a direction to oppose the motion of the measurement. The valve position always bears a fixed relationship to the measurement, and the peak value in valve motion ocurs at the point of greatest measurement deviation.

● **Proportional with Reset control.** When operating conditions and the proportional band of the controller are such that the maximum off-set is within the permissible variations of the controlled medium the proportional controller is satisfactory. When conditions are not satisfied, however, it becomes necessary

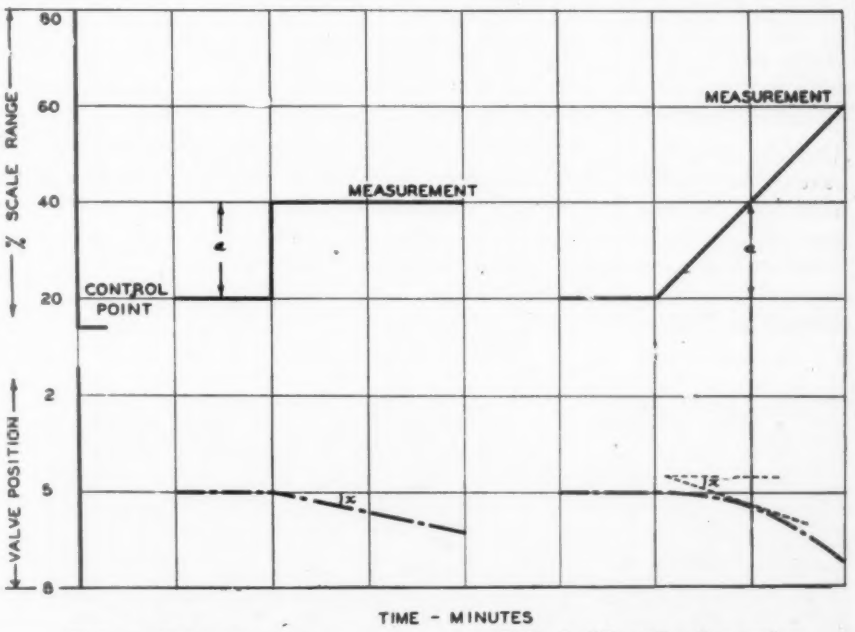

FIG. 3. "Reset" valve action with fixed deviation.

FIG. 4. "Reset" valve action with increasing deviation.

to add a second function to the controller to overcome these objections. This function is known as "reset." Fig. 3 illustrates the pure reset action for a sustained measurement deviation, showing that, whereas the measurement is deviated a given amount, the valve continues to move at a constant rate. Fig. 4, on the other hand, shows the reset action on an increasing measurement deviation, emphasizing that the rate of reset is increased as the deviation becomes greater. The fixed deviation "a" (Fig. 3) has produced a correction rate that is measured by the fixed angle "x" in Fig. 4, however, that rate of correction increases as the deviation increases and reaches a rate "x" determined by the angle between the tangent to the curve and the horizontal when the deviation reaches the value of "a."

Taken from the article, "Automatic Controls in Gas Operations," by L. W. Parten, The Foxboro Company, which was presented before the second annual Gas Technology Short Course, Texas College of Arts and Industries, Kingsville, Texas, May 27-30, 1947, and published in *The Petroleum Engineer*, Reference Annual, 1948, pages 189 to 200, inclusive.

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CHARACTERISTICS OF AUTOMATIC CONTROLS IN GAS OPERATIONS

The pneumatic controller is a device equipped with a measuring element capable of detecting changes in the variable to be controlled and translating these changes into movements of a valve capable of influencing the controlled variable.

In the usual proportional controller, it is possible to vary the amount the valve will be moved by a given measurement change by adjusting the proportional band of the instrument. The proportional band of a controller is defined as being the percentage of the scale through which the measurement must move in order to produce a travel of the valve from one extreme to the other. Thus, a 100 per cent proportional band controller is one where 100 per cent scale movement of the measurement is required to give 100 per cent valve movement.

It is important to understand that each valve position of a proportional controller is related to a definite position of the measurement. The controller may be adjusted so that the valve is positioned to bring the measurement to the desired value, but the measurement will be maintained at this point only so long as there is no change in load or other variables. If, for example, the pressure drop across the valve changes, then it must assume a new position in order to pass the original flow. Therefore, the measurement must first move to a new position that necessarily will be away from the control point. This drift from control point with load or condition change is known as "off-set." It may or may not be objectionable depending upon its magnitude and process requirements. It follows logically that the off-set on normal changes in load will be small when the proportional band of the controller is narrow, whereas it will be correspondingly larger, when the proportional band is wide.

By combining the proportional and reset functions in a single controller, the valve action for an increasing deviation will be the sum of the curves, Fig. 2 and 4 as shown in Fig. 5. The important point in Fig. 5 is the fact that there are two distinct reactions produced by a given measurement change. The amount of corrective action due to the proportional action will increase only as the magnitude of deviation increases, whereas the amount of corrective action due to reset will increase as the magnitude and duration of deviation is increased. In other words, one correction is governed primarily by the duration of deviation. Fig. 6 shows the combined result of the two curves in Fig. 5. This is the action that will be obtained by use of a proportional and reset controller.

Fig. 7 illustrates the motion of a measurement together with the motion of the valve. Unlike the previous curves, however, the measurement is being controlled by the valve. The initial movement of the measurement was caused by a sudden and sustained load change of considerable magnitude. The valve reacted to restore the measurement to the original control point, and it may be seen that the measurement was returned to the control point with a minimum of cycling.

It should be noticed also that the valve had assumed a new position when the measurement was returned to the control point. The original motion of the valve responding to the motion of the measurement was due to proportional action. The departure of the valve to its new position, however, was due entirely to reset. Had the controller been a simple proportional type where the position of the valve is related directly to the position of the measurement, the load change would still have called for a new valve position, but this could have been obtained only with a sustained deviation of the measurement. The system would therefore have been stabilized with both measurement and valve in new positions, unlike the reset controller that will place the valve in a new position with the measurement still at the control point.

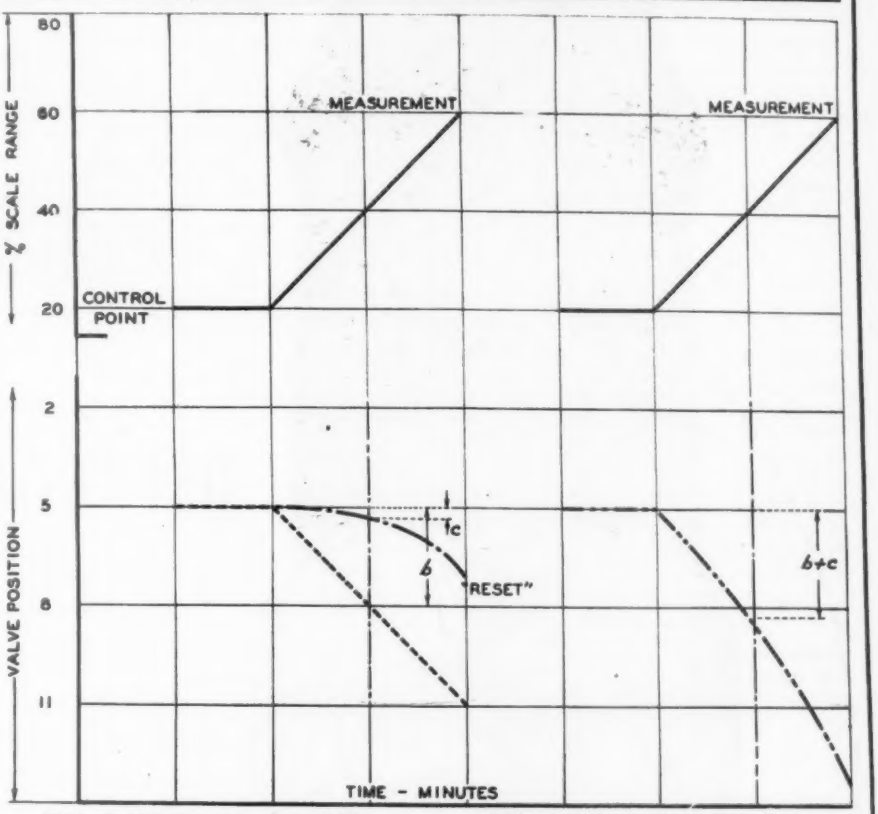


FIG. 5. "Proportional and Reset" valve actions (separated).

FIG. 6. "Proportional and Reset" valve action (combined).

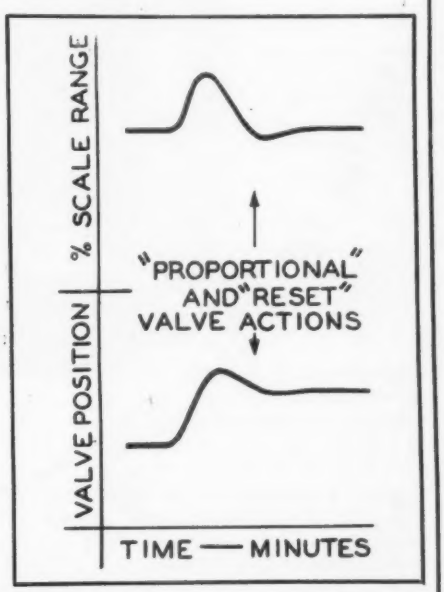
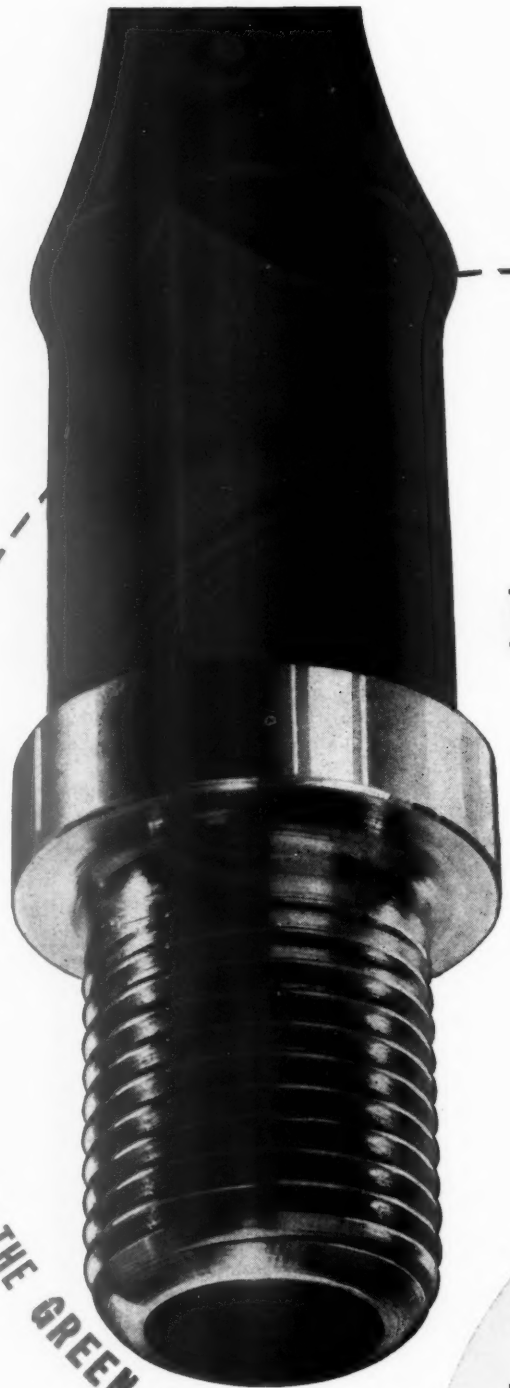
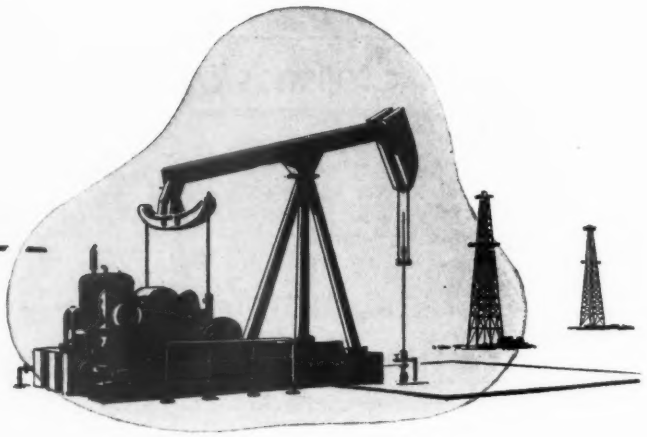


FIG. 7. Recovery curves for "proportional" and "reset" valve actions.

Taken from the article, "Automatic Controls in Gas Operations," by L. W. Parten, The Foxboro Company, which was presented before the second annual Gas Technology Short Course, Texas College of Arts and Industries, Kingsville, Texas, May 27-30, 1947, and published in *The Petroleum Engineer*, Reference Annual, 1948, pages 189 to 200, inclusive.





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CALCULATION OF WELL LOADS AND SELECTION OF PUMPING UNITS

Safety factors have probably been lowered in some cases in past years. It is believed that the rating of gears for pumping equipment is now as high as is desirable. It is desirable to rate equipment as high as it will operate satisfactorily and continuously, but when some of the safety factors that have been allowed are checked, trouble is given a hearty invitation to move in.

A step in the right direction was made when API and the American Gear Manufacturer's Association brought their rating formulas into agreement. The correlation had been studied for some time, was agreed on a year ago, and was adopted at the annual meeting of the API at Chicago in November, 1947. This will increase API ratings, but since API and AGMA are in agreement, rating formulas will probably remain unchanged for several years. Engine manufacturers and distributors are adopting the API suggested horsepower curve. There is a tendency to sell engines on the basis of their maximum hp curve rating, which is not satisfactory for application. Too often the operator assumes that an engine rated for 80 hp at top speed on the maximum curve can be installed to carry that load. Actually, the engine is rated and will produce only 35 to 40 hp continuously at operating speed, considering the Btu of the gas used and other correction factors that enter into the application. Such misapplication can be attributed to enthusiastic but inexperienced salesmen rather than to the manufacturer who wants applications that will allow the equipment to operate economically for a reasonably long period of time. The best provision against confusion on ratings and calculations is to select equipment from a reputable manufacturer who offers an engineered recommendation and application, and who can supply prompt and expert service with parts available immediately. A company that has built its reputation on good equipment, expert application, and dependable service cannot afford to allow the purchaser to make a serious application error.

At this point should be mentioned the fallacy of the use of "4950" as a method of correlating peak torque and horsepower. It has been accepted that nominal horsepower multiplied by 4950 gives peak torque in in.-lb based on a speed of 20 spm. This relation, however, was not suggested for speeds above or below 20 spm. Many of us are prone to use this conversion factor, however, and thus obtain incorrect applications. We assume peak torque should be used for the application of all pumping equipment rather than average hosepower or nominal horsepower. Several kinds of horsepower are misused interchangeably and, in the general discussion of equipment, tend to confuse many who have had neither the opportunity nor the time to make a complete study of all phases of production. Hydraulic horsepower is a familiar term with engineers. Polished-rod horsepower, in-put horsepower, nominal, and average horsepower have often been substituted for brake horsepower, or "just plain" horsepower. Average or nominal horsepower may be satisfactory on some applications of equipment that is for slow pumping on "normal" wells, but it is necessary to consider the load peaks in the selection of rods, pumping unit, and engine, especially when wells are operated at speeds above normal.

A reference was made earlier to the Smackover field. Load ranges similar to those found in other fields may be found in this area in Arkansas. A complete range of units from 5 hp to 117 hp is installed in this one field. Wells produce from four sands ranging from 2000 ft to 2600 ft in depth. Production ranges from 2 or 3 bbl to as much as 2000 bbl of fluid per day. The units are operating at speeds ranging from 5 spm on stripper wells to 35 spm on high fluid volume wells that use 3-in. tubing with 2¾-in. working barrels and 74-in. to 120-in. strokes.

Savings have been effected by replacing 6-ft stroke pumping equipment with units having a 9-ft or 10-ft stroke on high volume wells. Reduction in rod reversals has materially lengthened the life of the subsurface pumps, sucker rods, and tubing. It was also found that power costs were reduced as much as 25 per cent in some instances where 6-ft stroke units operating at 30 spm were replaced by 9-ft stroke units operating at 20 spm. The same amount of fluid was produced.

Most of this equipment is powered by electric motors. It was also found on both stripper wells and large volume wells that operating costs dropped materially when individual pumping units replaced standard rigs or band wheel powers. Records indicate that the cost of the new equipment, including motors and installation, was paid back in an average period of 2.43 yr by reduction of down-time, saving on labor costs and materials, and by increased production.

Proper counterbalancing was an important factor in the use of electric motors. Counterbalancing is necessary to keep gear load peaks as low as possible and to keep power costs at a minimum. Adjustable type counterbalances tend to reduce the need for winch trucks and extra men to change the weights. Several manufacturers now offer adjustable counterbalance cranks on which counterweights can be handled and adjusted easily by the pumper.

It may be inviting criticism from the "engine" men in presenting our methods for applying engines to pumping loads, and some will not agree with the "rule of thumb" method we find satisfactory. If the cubic displacement of a multi-cylinder engine is divided by 15, a horsepower capacity figure will be obtained that will be very close to the output of the engine at its operating speed. For example, 334 cu in. displacement divided by 15 gives about 22½ hp for an application. As a 4-cylinder engine has a normal operating speed range of 900 to 1200 rpm, it would suggest operating the engine at 1000 rpm for 20 spm. Experience shows that an engine of this size will handle economically an actual load of 20 to 25 hp for an extended period of time.

In applying engines, it must be taken into consideration also that there is usually a loss of 30 per cent or more from engine to polished rod, so, if you have a 20-hp load at the polished rod, an engine of about 30 hp should be used to handle this load satisfactorily. On engine loads as on pumping unit loads, peaks must be considered. Average horsepower applications may not allow sufficient capacity to handle the peak loading to which the engine will be subjected. An overload condition may exist causing premature failure, although the average load may indicate that the equipment has sufficient capacity.

Engine manufacturers use and suggest formulas similar to the one shown here for application of their product to pumping loads:

$$\text{Bhp} = \frac{D^2\ LS\ \text{spm}}{600{,}000}$$

Where:
D = pump size
L = depth, and
S = stroke length

In selecting engines by this formula, it is suggested that the API rating curve on the engine be used or multiply the maximum horsepower shown at the correct operating speed by a factor of 0.65 to get maximum engine capacity for application to pumping loads.

Some readers may not be in complete agreement with all methods and figures suggested. The methods are presented only after they have been discussed in detail with other engineers who have thoroughly studied them.

The thought involved in the selection of methods is generally based on experience gained under different circumstances. Each area, each field, and, in many cases, each well in a field may require a different approach to the selection of the proper equipment. The method is not so important, but it is necessary that the final solution and application be correct for a particular condition. The described methods have been found satisfactory in arriving at those correct answers and the proper applications.

Taken from the exclusive article, "How to Calculate Well Loads and Select Pumps," by A. Ed Caraway, Dallas Division Manager, Lufkin Foundry and Machine Company, published in *The Petroleum Engineer*, June, 1948, pages 108 to 113, inclusive.

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DRILLING CHARACTERISTICS OF DRAG TYPE ROTARY BITS

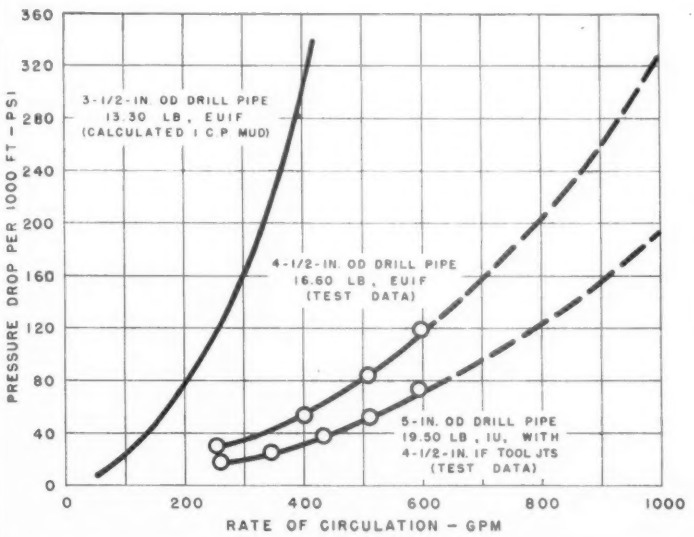

FIG. 2. Pressure drop through drill pipe (natural shale mud—viscosity under flow conditions not determined for test data—mud weight 10.3 lb per gal.

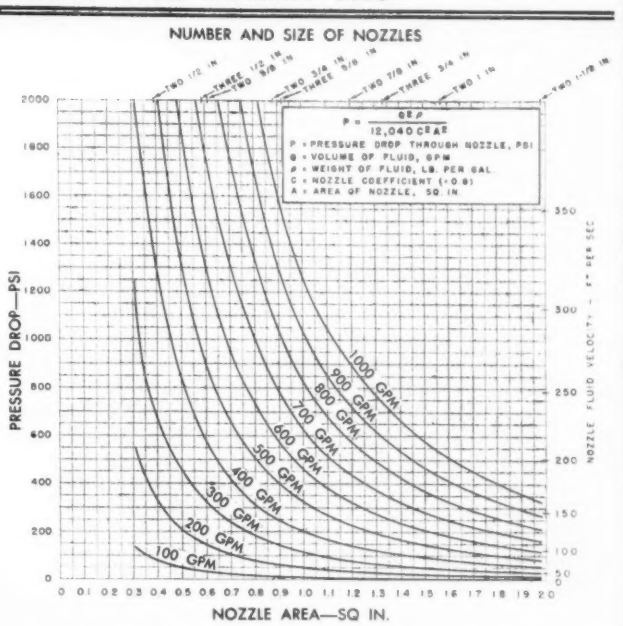

FIG. 3. Calculated pressure drop through drilling bit nozzles (mud weight, 10.0 lb per gal).

Drag bits used in early day rotary drilling were usually hand-forged and crudely heat-treated at the drilling site. Present day commercial types of drag bits, as illustrated by Fig. 1, are equipped with heat-treated, drop-forged steel blades. Tungsten carbide inserts applied to the face of the blades and to the reaming edges account for a tremendous increase in footage per bit in comparison with the early designs. Other improvements, such as replaceable blades that prolong bit body life have also been developed.

Drilling fluid nozzles in most current bit designs are replaceable steel alloy tubes, usually one per blade, welded into the bit body. Although some drillers have maintained a preference for nozzles of small bore, the materials used for nozzle tubes have not been adequate to withstand the abrasive action of drilling fluids at high velocities. Consequently, the trend has been to employ nozzles of a bore sufficiently large that destructive fluid velocities are not attained even with the larger circulating pumps. Current practice embodies the use of nozzles ranging from 7/8 in. to 1¼-in. bore with resultant nozzle fluid velocities of from 50 to 200 fps and with apparently little thought being given to the possible effect of nozzle fluid velocity on rate of drilling.

As shown by test data in Fig. 2, the pressure drop per 1000 ft of 5-in. OD, IU drill pipe equipped with 4½-in. IF tool joints is approximately 40 per cent less than the pressure drop through 4½-in. EUIF drill pipe. The 5-in. OD drill pipe was field tested in several wells and satisfactory performance from the standpoint of all drilling requirements was obtained when used with the same sizes of holes (8⅝-in. and larger) that were drilled while using 4½-in. OD drill pipe. In addition to the decreased pressure drop, the 5-in. drill pipe offers 33 per cent greater torsional strength than 4½-in. drill pipe.

FIG. 1. Commercial type two-way drag bits.

Another means of circulating a maximum volume of mud with available equipment is to enlarge bit nozzles. The pressure drop through bit nozzles was investigated, and it was found that two 1⅛-in. nozzles, as shown by theoretical data in Fig. 3, required a pressure of from 50 to 200 psi when used with circulating rates on the order of 400 to 700 gpm. The calculated pressure drops have been found in close agreement with the data obtained from field tests.

NOTE: References are shown on last sheet in this series of tables.

Taken from the article, "The Relation of Nozzle Fluid Velocity to Rate of Penetration With Drag Type Rotary Bits," by J. P. Nolley, George E. Cannon, and Douglas Ragland of Humble Oil & Refining Company, which was presented before Southwestern District API Division of Production, San Antonio, Texas, April 14-16, 1948, and published in *The Petroleum Engineer*, June, 1948, pages 86 to 102, inclusive.

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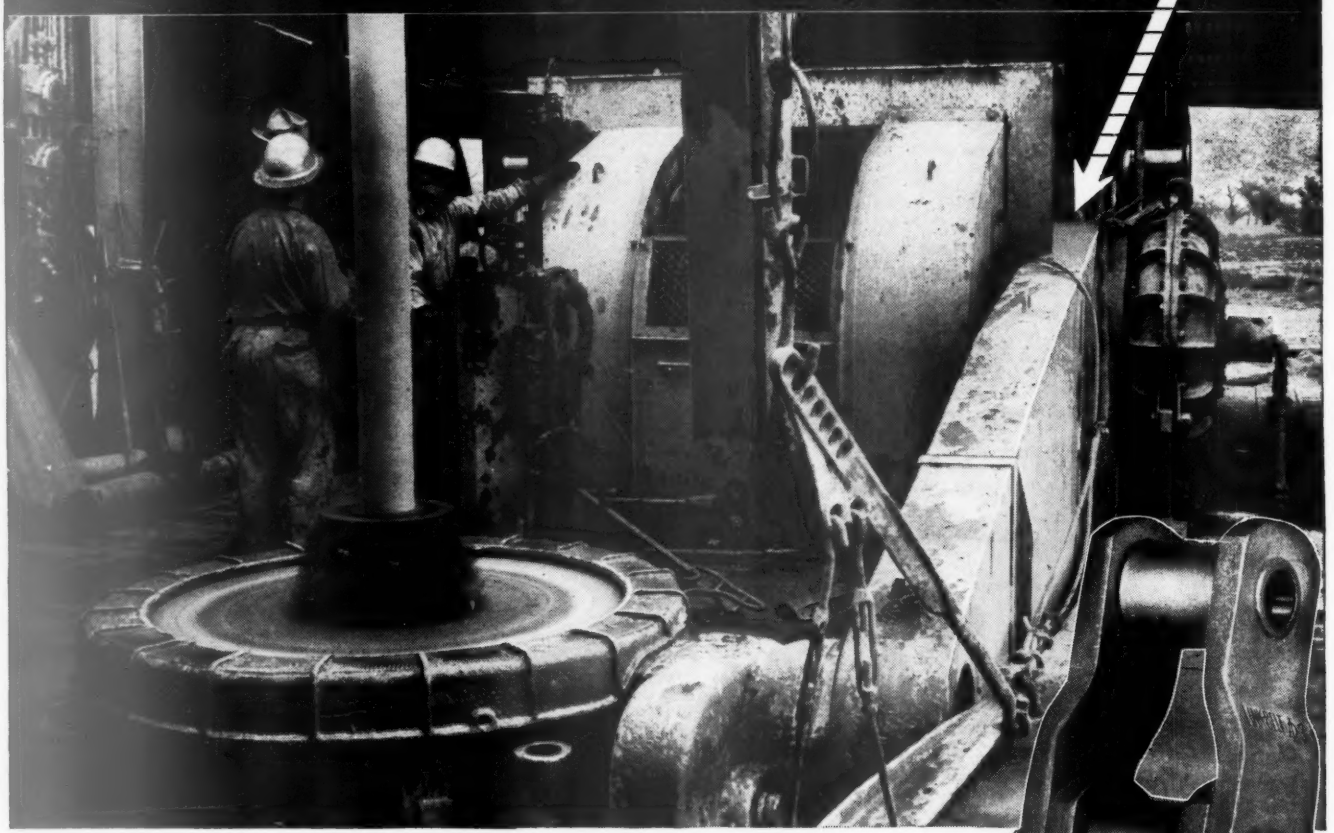

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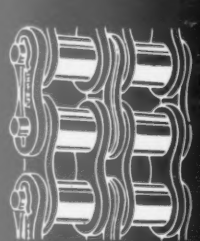

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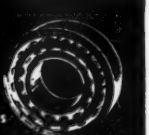


DRILLING CHARACTERISTICS OF DRAG TYPE ROTARY BITS

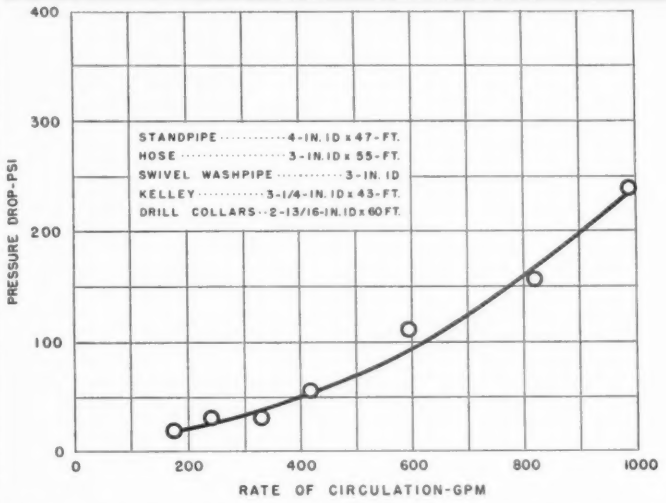

PRESSURE DROP-PSI
STANDPIPE ····· 4-IN. ID x 47-FT.
HOSE ····· 3-IN. ID x 55-FT.
SWIVEL WASHPIPE ····· 3-IN. ID
KELLEY ····· 3-1/4-IN. ID x 43-FT.
DRILL COLLARS ··· 2-13/16-IN. ID x 60 FT.
RATE OF CIRCULATION-GPM

FIG. 4. Pressure drop through surface connections (natural shale mud-viscosity under flow conditions not determined—mud weight 10.0 lb per gal.

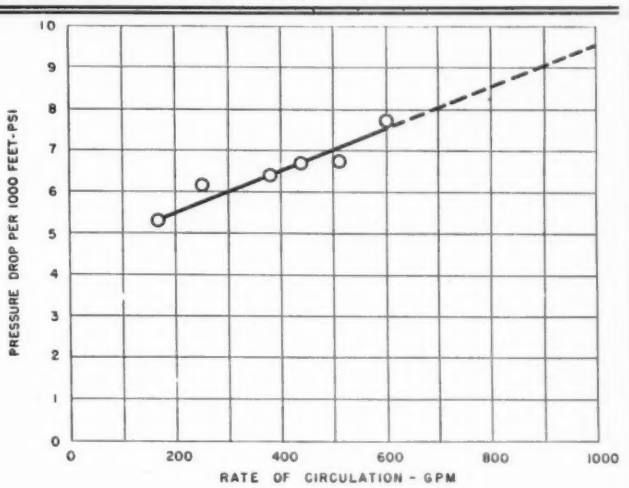


FIG. 5. Pressure drop through annular space with 5-in. OD 19.50 lb drill pipe in 8.83 in. ID casing (tool joints, 4½-in. IF; mud weight 10.3 lb per gal: mud viscosity not determined under conditions of flow).

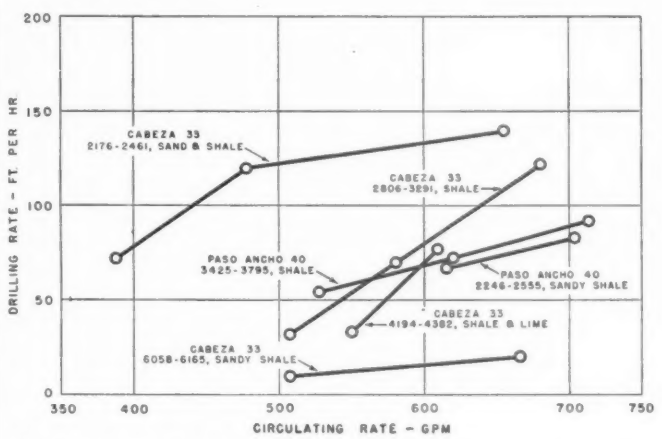

DRILLING RATE - FT. PER HR.
CABEZA 33 2176-2461, SAND & SHALE
CABEZA 33 2806-3291, SHALE
PASO ANCHO 40 3425-3795, SHALE
PASO ANCHO 40 2246-2555, SANDY SHALE
CABEZA 33 4194-4362, SHALE & LIME
CABEZA 33 6058-6165, SANDY SHALE
CIRCULATING RATE - GPM

FIG. 6. Variation of drilling rate of two-way drag type bits with rate of circulation at constant nozzle diameter (speed of rotation 85 to 110 rpm; bit weight, 6000 to 10,000 lb; bit nozzle sizes not recorded; mud properties constant but not recorded —South Texas area).

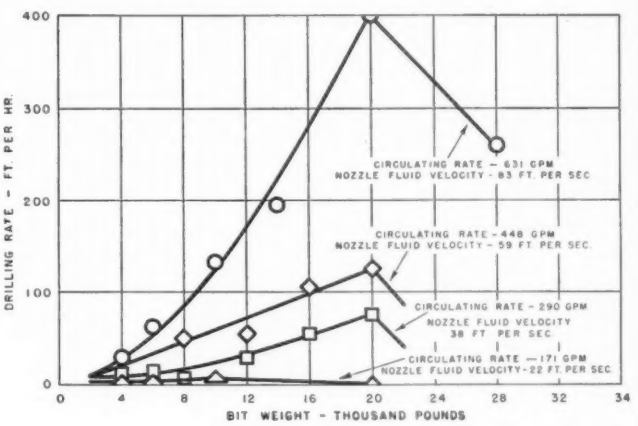

DRILLING RATE - FT. PER HR.
CIRCULATING RATE - 631 GPM NOZZLE FLUID VELOCITY - 83 FT. PER SEC.
CIRCULATING RATE - 448 GPM NOZZLE FLUID VELOCITY - 59 FT. PER SEC.
CIRCULATING RATE - 290 GPM NOZZLE FLUID VELOCITY 38 FT. PER SEC.
CIRCULATING RATE - 171 GPM NOZZLE FLUID VELOCITY - 22 FT. PER SEC.
BIT WEIGHT - THOUSAND POUNDS

FIG. 7. Combined effect of circulating rate, nozzle fluid velocity, and bit weight at constant speed of rotation on rate of drilling with two-way drag type bits (mud properties constant, uniform shale; King Ranch-Cabeza 68 well—3110 to 3212 ft. South Texas area).

The pressure drop through the standpipe, hose, swivel, kelly, and drill collars, as shown by test data in Fig. 4, was not considered great enough to alter the size of any of these pieces of equipment. The small magnitude of the return losses is shown by Fig. 5.

In addition to the means adopted for circulating the maximum volume of drilling fluid with available equipment, Humble conducted drilling tests in seven wells during the latter part of 1944 to determine further the relationship of circulating rate to drilling rate. The results obtained in five of these wells are shown in Table 1, and the results obtained in the remaining two are illustrated in Fig. 6. The tests shown in Table 1 were conducted by alternating single and compound pump operation between joints, whereas the test results shown in Fig. 6 were obtained by throttled operation of a single 20-in. duplex pump while drilling from 43 to 175 ft of hole at each rate of circulation in uniform formation.

TABLE 1. Preliminary studies of effect of circulating rate on drilling with commercial drag type bits—*South Louisiana area*

Lease and well number	Average circulating rate, gpm			Average drilling rate, ft per hr.		
	Single pump	Compound	Per cent increase	Single pump	Compound	Per cent increase
Sarpy Brothers 1—1400 ft Predominantly sand	483	596	23.4	20.6	21.7	5.3
Petit Anse Co. Inc. B-3—639 ft Broken sand and shale	508	567	10.6	22.1	24.1	9.0
M. Wooster B-7—170 ft Sand and Shale	395	437	10.6	9.1	9.0	— 1.1
So. Tex. Rice Prod. 2—1046 ft Sandy shale	466	634	36.0	37.7	54.7	45.0
State Land A-30—1027 ft Sand and shale	454	517	13.8	24.0	21.6	—10.0

NOTE: References are shown on last sheet in this series of tables.

Taken from the article, "The Relation of Nozzle Fluid Velocity to Rate of Penetration With Drag Type Rotary Bits," by J. P. Nolley, George E. Cannon, and Douglas Ragland of Humble Oil & Refining Company, which was presented before Southwestern District API Division of Production, San Antonio, Texas, April 14-16, 1948, and published in *The Petroleum Engineer*, June, 1948, pages 86 to 102, inclusive.

What He Says about KINKING

One of the quickest ways to ruin a wire rope is to let it kink. That, says the Bethlehem engineer, is certain death for the rope. Even though your eye may detect no damage . . . it's been done. For kinking throws wires and strands out of harmonious balance; leads to spot wear and wire breakage long before the rope has lived its normal life.

Improper unreeling is a common cause of destructive kinking. Never lay the reel on its side without a turntable and attempt to lift off the rope. That's just asking for trouble. Instead, jack up the reel so that it revolves freely; then, while one man "brakes" the reel, another should slowly pull off the rope in a straight line.

Be careful, too, when handling a *coil* of rope—one not wound on a reel. Merely grabbing the rope and starting to pull will invariably produce damaging loops and kinks. To uncoil, place the end of the rope on the ground, then roll the coil like a hoop, in as straight a line as possible.

The Bethlehem field engineer will gladly give any helpful pointers on the proper way to unreel and uncoil wire rope. It's something *every* user of rope should know.

Remember, there's no charge for the services of the Bethlehem representative, no matter how much time he spends with you. It's his job to help you in selecting wire rope and getting the best service from it. Feel free to call him on any wire-rope problem.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

Export Distributor: Bethlehem Steel Export Corporation

When you think WIRE ROPE . . . think BETHLEHEM

DRILLING CHARACTERISTICS OF DRAG TYPE ROTARY BITS

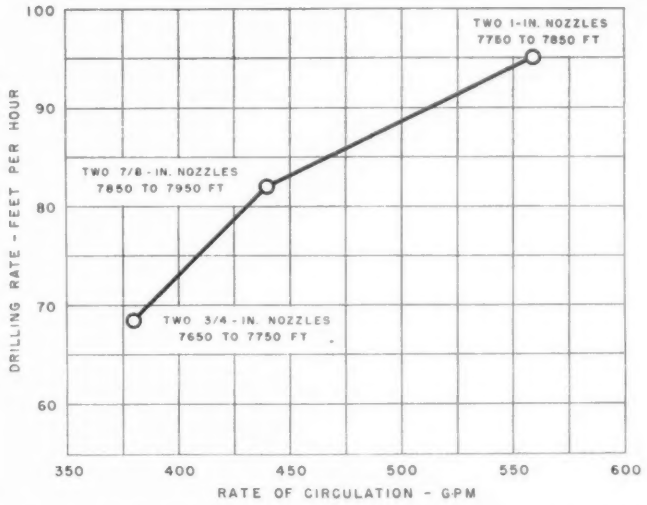


FIG. 8. Variation of drilling rate of two-way drag type bits with rate of circulation at near constant nozzle fluid velocity, constant speed of rotation and maximum effective bit weight (nozzle fluid velocity, 116 to 138 ft per sec: Bit weight 8,000 to 10,000 lb; uniform shale formation; mud properties constant but not recorded; speed of rotation, 140 rpm—Gulf Coast, Texas area).

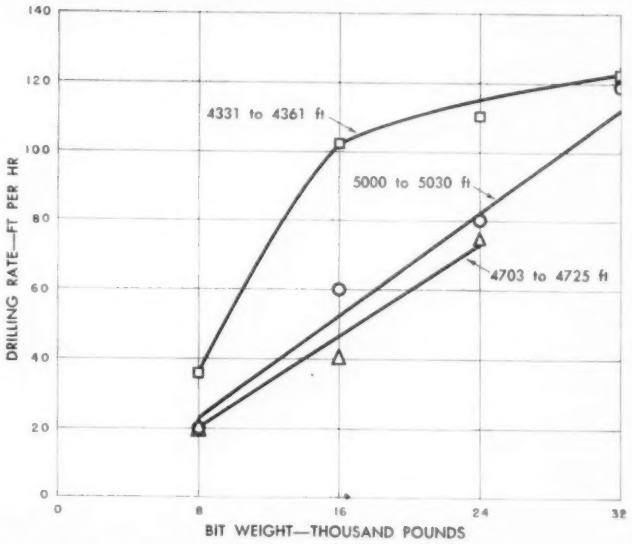


FIG. 9. Variation of drilling rate of two-way drag type bits with bit weight at constant rate of circulation and speed of rotation (King Ranch-Cabeza 67 well—4331 to 5030 ft; uniform shale formation; mud properties constant but not recorded: Rate of circulation 820 gpm; nozzle fluid velocity, 107 ft per sec.—South Texas area).

TABLE 2. Effect of nozzle fluid velocity on rate of drag bit drilling at constant rate of circulation.

Gulf Coast Texas area

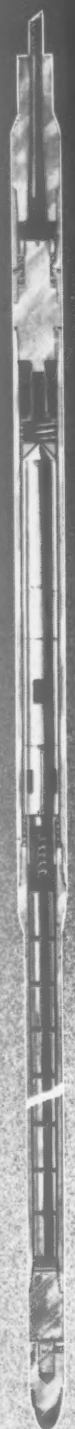
Bit no:	Number of nozzles per bit	Size nozzles, in., ID	Rate of circulation, gpm	Nozzle fluid velocity, fps	Feet drilled	Bit weight, lb	Drilling rate, ft per hr
F. J. Grant 3							
Interval 1—4312 to 5050 ft							
1	2	5/8	700	365	138	8,000	151
4	2	5/8	700	365	150	8,000	204
3	2	1	700	142	150	8,000	72
2	2	13/16	700	75	150	8,000	82
5	2	13/16	700	75	150	8,000	63
Interval 2—6200 to 6600 ft							
9	2	5/8	630	328	100	8,000	94
7	2	1	630	129	100	8,000	53
8	2	21/16	630	30	100	8,000	28
9	2	5/8	630	328	50	14,000	71
7	2	1	630	129	50	14,000	88
Interval 3—6607 to 7050 ft							
12	2	5/8	630	328	53	4,000	66
10	2	1	630	129	68	4,000	78
11	2	13/8	630	68	75	4,000	56
12	2	5/8	630	328	75	8,000	64
10	2	1	630	129	75	8,000	66
11	2	13/8	630	68	75	8,000	51
Frank Schmidt 3							
Interval 1—5000 to 5293 ft							
1	2	5/8	628	327	100	10,000	193
3	4	1/2	628	256	100	10,000	80
5	2	1	628	128	27	10,000	33
4	4	3/4	628	113	38	10,000	22
2	2	13/8	628	67	63	10,000	20
Interval 2—5366 to 5866 ft							
6	2	5/8	570	296	100	4,000 to 6,000	182
8	4	1/2	570	232	100	4,000 to 10,000	122
10	2	1	570	115	100	4,000 to 6,000	87
7	4	3/4	570	103	100	4,000 to 10,000	47
9	2	13/8	570	61	100	2,000 to 4,000	46

The data in Fig. 8 show that as the circulating rate increased from 381 to 568 gpm, or 49 per cent, the drilling rate was increased from 65 to 97 ft per hr, or 49 per cent. The nozzle fluid velocity during the test only varied from 116 to 138 fps. Such a variation is believed to be too small to result in any appreciable effect on the drilling rate. The drilling rate in the well referred to above was, therefore, considered to vary directly with the circulating rate.

The effect of bit weight on drilling rate was investigated further during tests conducted from 4331 to 5030 ft in the King Ranch Cabeza 67 well, Seeligson field, where 6-ft intervals of uniform shale in each test were drilled at various bit weights while the circulating rate and nozzle fluid velocity were maintained constant at 820 gpm and 107 fps, respectively. Indications during the tests were that the bit was clean at all bit weights; therefore, the factor of a balled up bit did not enter into the tests. The results of the tests illustrated graphically in Fig. 9 show that the drilling rate varies directly with bit weight. A maximum bit weight of 32,000 lb was used during the tests because of a limited number of drill collars in use. Had enough bit weight been applied to the bit, however, balling up would have occurred, and rate of drilling would have slowed or stopped.

NOTE: References are shown on last sheet in this series of tables.

Taken from the article, "The Relation of Nozzle Fluid Velocity to Rate of Penetration With Drag Type Rotary Bits," by J. P. Nolley, George E. Cannon, and Douglas Ragland of Humble Oil & Refining Company, which was presented before Southwestern District API Division of Production, San Antonio, Texas, April 14-16, 1948, and published in *The Petroleum Engineer*, June, 1948, pages 86 to 102, inclusive.



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Lafayette, La. Bakersfield, Calif. Moulden Oil Field Services, Casper, Wyo.

APPLICATION AND EFFECT OF MINERAL WOOL INSULATION ON REFINERY EQUIPMENT

● **Case 1.** This case is of the insulation of a medium-sized asphalt tank. It is noteworthy because electricity is used in heating the tank. As the cost of this "fuel" is notoriously high, it is doubly important that heat losses be kept at an absolute minimum.

Provision of an air space between the tank exterior and the insulation is a second unusual feature of this installation. The insulation consists of 4-in. thick mineral wool blankets encased in diamond-mesh expanded-metal lath on both sides and held together with tie wires. Narrow clips were spot welded to the tank surface on 8-in. centers so that 8-in. clip-legs stuck out from the tank. The blankets were impaled on the clip-legs to within 2 in. of the tank, thus forming the air space.

After the blankets were pressed into place, the protruding 2-in. clip-leg projections were bent over to hold each section in place. A ¾-in. coat of mineral wool insulating cement, troweled into the lath that acts as a key, forms the base for a weather-sealing asphalt coating ½ in. thick. After the insulating cement had dried through, it was covered with 1-in. poultry netting over which an asphalt seal was applied.

Normally, 2 in. of mineral wool would be recommended for a surface operating at 300-350 F, but with the high-cost energy used for heating, extra thickness is amply justified.

Considerable interest attaches to the method of heating the tank. The underside contains heating coils rated at 45 kw. Heat generated moves over the entire surface of the tank through the air space, which explains the need for the unusual arrangement described. A small heater (2.4 kw) on the delivery pipe keeps the asphalt in the line sufficiently fluid to avoid plugging.

● **Case 2.** Case 2 is of a high-temperature flue gas duct and leads from a refinery tubestill to its stack. It has an area of 700 sq ft and an operating temperature of 620 F.

As the duct is carrying high temperature gases and is situated out-of-doors, seven steps are required to insulate it. If it was indoors the last step could have been omitted. If it was indoors and carried heated contents at room-heating temperatures, only the first three steps would be required.

The seven steps actually required in this case are:

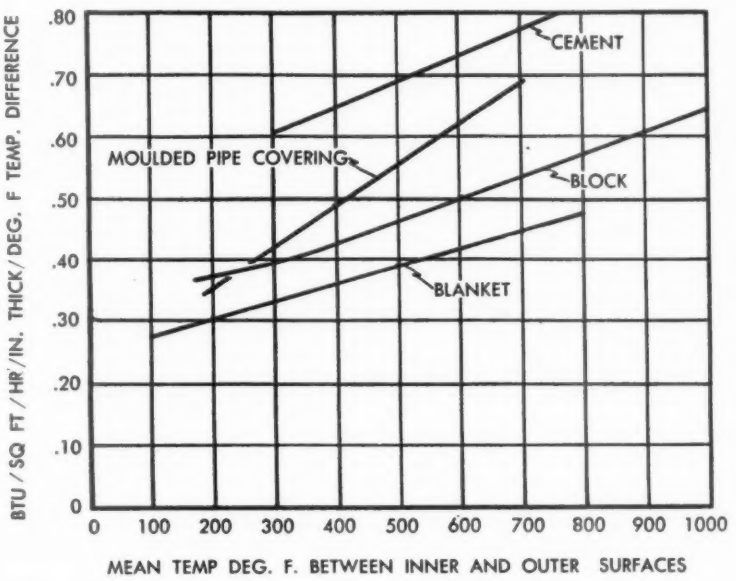
(1). Clean the surfaces of the duct of all grease and dirt.

(2). Cut mineral wool blocks to conform to the area to be insulated.

(3). Wire the blocks to the ducts. Galvanized or expanded metal angles are recommended to keep the blocks in line at the corners.

(4). Trowel a ½-in. coating of mineral wool insulating cement over the surface of the blocks.

FIG. 1. Graph showing thermal conductivity of mineral wool insulation.



(5). Follow this with a layer of 1-in. mesh poultry netting.

(6). Apply a ¼-in. coating of finishing cement.

(7). Apply at least ⅛-in. weatherproof protective coating.

The duct was operated for a time uninsulated, and after insulating, the following advantages were achieved: (1) Flue gas was maintained at a higher temperature and the draft was improved, (2) workmen were afforded protection from the heat, and (3) the duct was weatherproofed and hence its life was prolonged.

● **Case 3.** The insulation of seven butane storage tanks provided an interesting illustration of a large spherical storage tank installation. The problem was to insulate seven spheroidal butane storage tanks so that 280,000 bbl of liquid butane could be stored at 45-50 F and 20-25 psi without the use of heavy steel tanks or excessively large refrigerating units. To store the butane at atmospheric pressure would require cooling to below 32 F, and would require a great quantity of insulation and refrigeration equipment. To store without any cooling would require pressure vessels capable of handling up to 90 psi internal pressure, and would necessitate costly steel construction.

In solving the problem, the point of greatest economy was determined to be storage at 45-50 F under 20-25 psi pressure with 1 in. of mineral wool board, or block, insulation. Standard sized boards were stuck to the metal surface with hot asphalt. Galvanized wires, welded to the steel tank and projecting through the insulation, were attached to poultry netting applied to the outside surface of the boards. The finished job was weatherproofed with a troweled-on asphalt mastic coating.

● **Case 4.** Case 4 deals with perhaps the greatest Btu wasters in otherwise efficient plants — namely, flanges, valves, and fittings.

As the small size is often deceiving with regard to how much heat can be dissipated by flanges, valves, and fittings, the following hypothetical example is given.

Assuming 10 sets of 6-in. companion flanges having a bare surface area of 1.82 sq ft each and operating at 350 F. Assume each flange is insulated with 2 in. of insulating cement.

The bare heat loss = 798 Btu × 1.82 sq ft × 8760 hr = 12,722,673 Btu/yr (Kent, page 3-64).

The insulated loss = 64 Btu × 2.73* sq ft × 8760 hr = 1,530,547 Btu/yr (Kent, page 3-67).

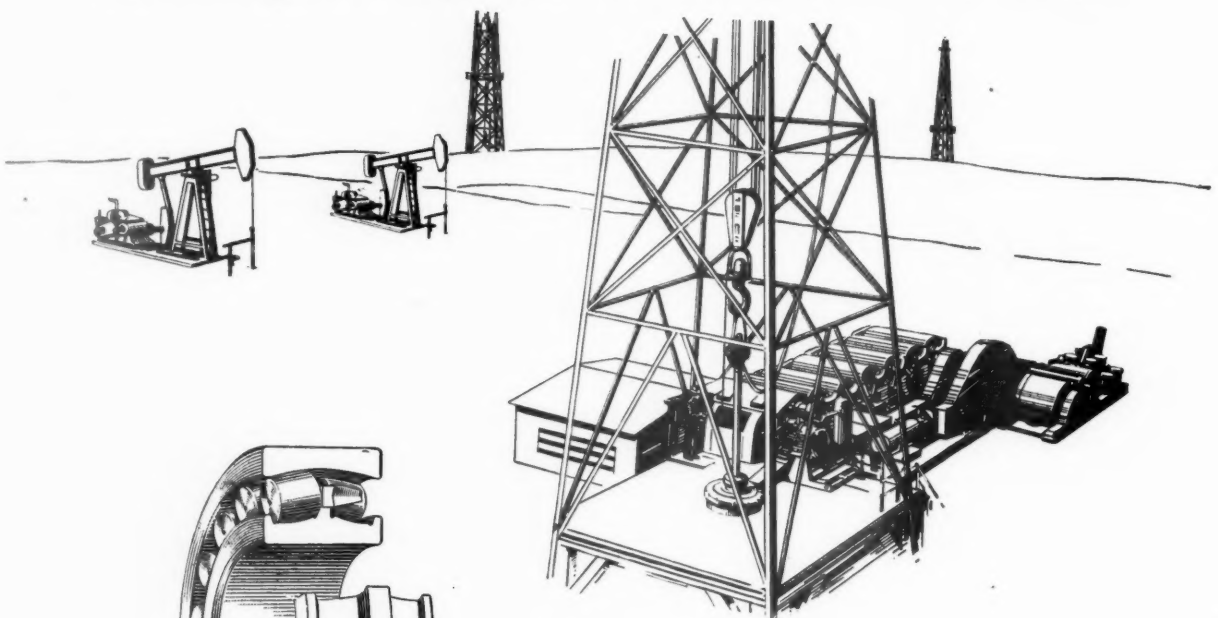
Subtracting, 12,722,673 less 1,530,547 = a saving of 11,192,126 Btu/yr.

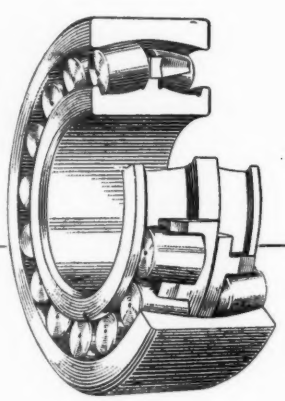
Assuming the use of an oil fuel having a heat content of 145,000 Btu per gal, and assuming an operating efficiency of 60 per cent, the saving is equivalent to 1286 gal of oil per year. At present insulation, labor, and fuel costs, the installation would pay for itself in about seven months.

*50 per cent added to bare surface area to get outside area after insulating.

Taken from the exclusive article, "Mineral Wool Insulation for Processing Equipment," published in *The Petroleum Engineer*, August, 1948, pages 64 to 68, inclusive.

For Rugged day-in, day-out Performance of Oil Field Equipment Count On Torrington Spherical Roller Bearings





. . . high radial capacity of these self-aligning roller bearings is an important advantage in oil field equipment.

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Petroleum Profiles

T. R. GOEBEL

Columbian Carbon Company

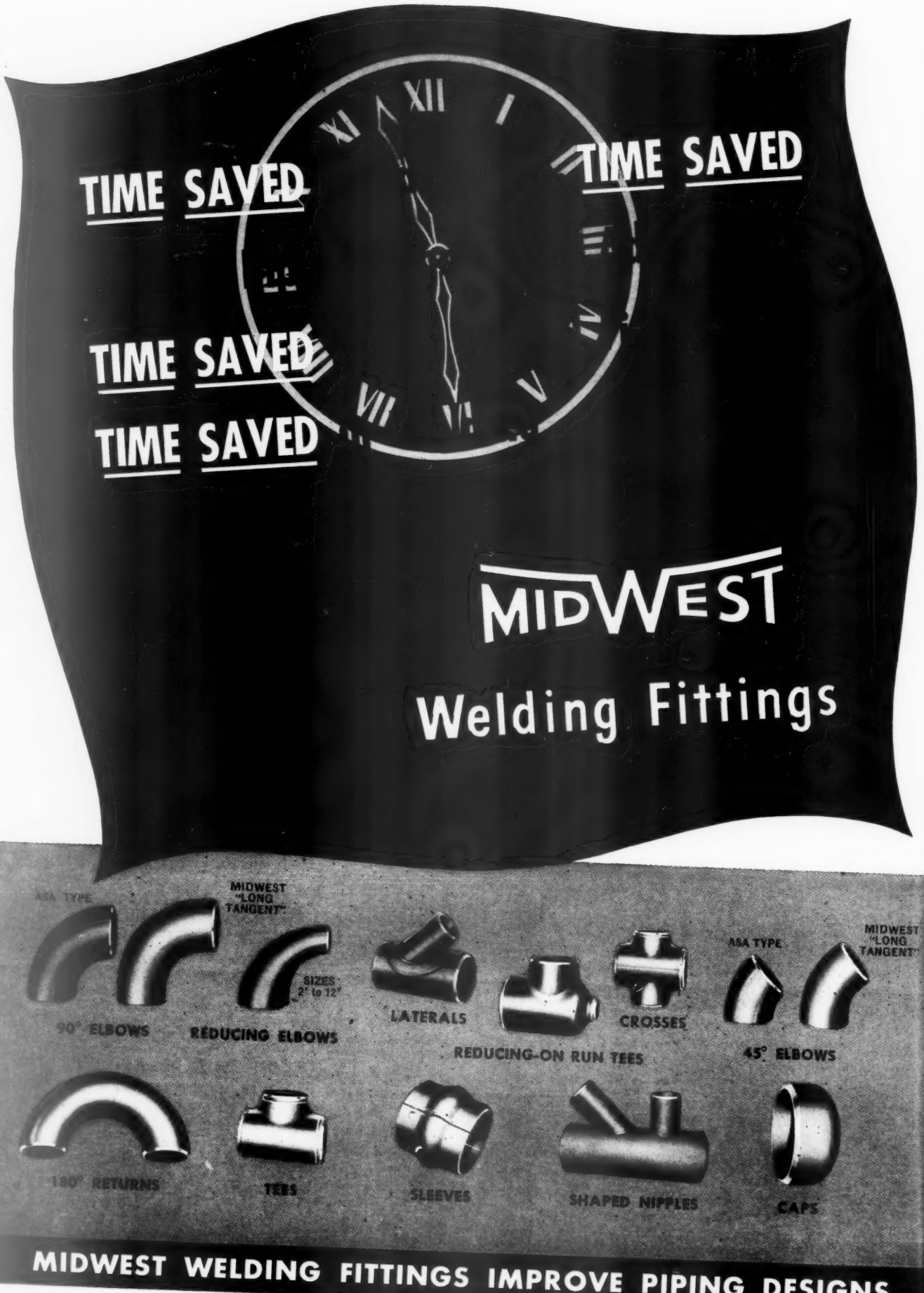
T. R. GOEBEL has been elected a vice president of Columbian Carbon Company, of New York, effective November 1, 1948. He will establish offices for that company in Houston, Texas, and will be in charge of all oil, gasoline, and gas activities of that company. This move is a new one for Columbian, and is their plan to enlarge their activities in these fields. Goebel has been for several years regional director of the gas-gasoline department of Shell Oil Company, Inc. east of the Rockies.

"Ted" Goebel (T. R. to you, for five minutes after introduction), started life as an infant, in New Jersey back when camera shutters and automobile horns were operated manually with rubber bulbs. After school days passed he began as a southwesterner by peeping over the horizon of Texas early in World War I from a troop train as a QM sergeant SG, and never changed his mind.

Discharged from "This Man's Army" in 1918, he joined Sinclair Oil and Gas Company, finally transferred to Tulsa in 1922. Skelly Oil Company evidently needed someone to straighten out its accounts, for he was appointed chief accountant for that outfit and climbed successively to manager of the gas contract department, to executive assistant to president W. G. Skelly. Those were strenuous days and years for the natural gas-gasoline industry; prices plummeted from 25 cents per gallon of 'wild' stuff in the early 'teens to a tenth of that twenty years later and the shoestring on which gasoline producers operated showed far more knots than clear string. The 'stepchild of the refining industry' was well nigh disowned. The steady, guiding hand of "Camera Syd" Smith had released Shell Oil Company's Mid-Continent natural gasoline department for other jobs in the company and Ted was handed that department to manage. In two years he changed his office hatrack to Houston and was promoted to regional director.

MEMBERSHIP rosters of the important associations of the oil and gas industries have held his name for more than a quarter-century. He belongs to American Petroleum Institute, is active in Natural Gasoline Association of America, its president from 1935 to 1937, and director to date. Also works with the American Gas Association and the hard-driving California Natural Gasoline Association. Shaded by war clouds, in 1941 Ted took the secretaryship and treasurer's job in PAW's District 3 Natural Gas and Gasoline Committee; in five of the greatest gas and oil producing states he helped coordinate operations so that the GI's would have enough fighting fuel, in time. Getting things done becomes a habit with some people.

"Catch it on the Downbeat" might be a slogan for some of Goebel's less serious enjoyments, in which, on frequent occasions, he still indulges. He is a charter member of the famous national institution, SPEBSQSA—not an unpronounceable spelling of a Czech word, but the mnemonic abbreviation of the "Society for the Preservation and Encouragement of Barber Shop Quartet Singing in America." He owns a green thumb and gardens with vigor and a wide knowledge of the art of growing things in the mile-deep soil of the Gulf Coast. Two children call him Dad, a petroleum engineer son and a housewife daughter; he is a grandfather and works at it.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But savings in time and cost are not the only advantages offered by Midwest Welding Fittings. Simplified and improved piping design is also often possible. For example: the Midwest Reducing Elbow (available in sizes through 12") decreases pressure drop and turbulence when used instead of a standard elbow and reducer (it also saves more than ⅓ of the welding). Midwest Long Tangent Elbow removes weld from point of maximum bending stress and is designed to permit use of slip-on flanges. Midwest Saddles compensate for weakening of header body resulting from metal removal for nozzle opening. Midwest Sleeves relieve butt welds of bending and tensile stress. There is a distributor near you . . . it will pay you well to call on him for your welding fitting requirements.

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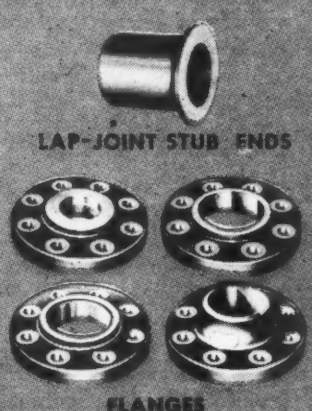

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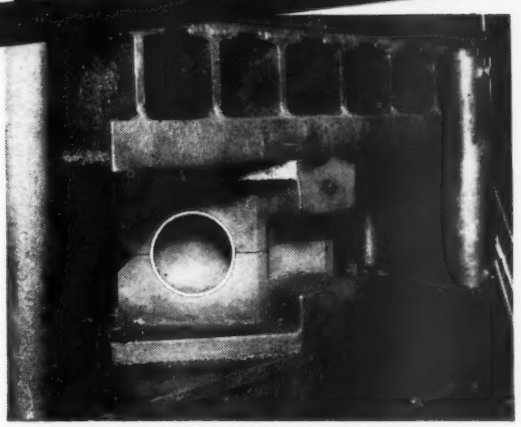

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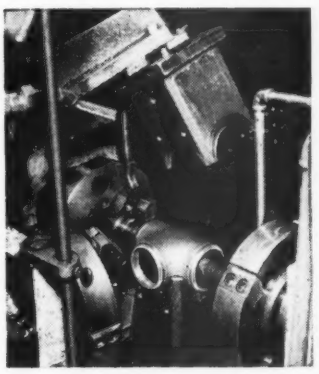
Special machines developed by Midwest simultaneously bevel the ends of Midwest Welding Fittings. This assures exact included angles and holds center-to-end dimensions well within tolerance specifications.



FINAL INSPECTION

Every Midwest Welding Fitting is individually checked to insure that the high standards of precision are maintained.

PERSONALS

Dr. Robert E. Wilson, chairman of the board, Standard Oil Company (Indiana), has been named chairman of the committee on research of the board of directors of the American Petroleum Institute, President William R. Boyd, Jr., announced. Wilson succeeds the late **Harry Weiss.**

Sidney A. Swensrud, president of Gulf Oil Corporation, succeeds Wilson as chairman of a special committee "to determine the type and scope of a fundamental study of the economic processes of the petroleum industry." **John W. Boatwright,** general manager, distribution economics department, Standard Oil Company (Indiana) was named to this committee to replace Wilson.

William H. Maloney is the new Blackmer Pump Company manager at the Los Angeles branch sales office, it was announced from Grand Rapids, Michigan, the home office. Before joining the Blackmer organization, Maloney was head of the grinding spindle sales division of Ex-Cello-O Corporation, Detroit, and later was vice president of the Detroit Bond and Reference Company. Previously, he spent three years in the Air Force as a bombardier, and prior to that was in the production planning department of General Motors Corporation.

It was also announced by Blackmer that their Los Angeles sales and service offices have been moved from 415 South Central Avenue to 736 East Washington Boulevard.

E. B. Hill W. H. Hammond

C. W. Perelle, president of Gar Wood Industries, Inc., announced the resignation of **W. H. Hammond** as vice president of sales. After a vacation Hammond will assume a distributorship of the company's products. **E. B. Hill,** general sales manager, will assume overall responsibility for sale and distribution.

L. C. Richardson, formerly with Grinnell Company at Houston, has joined Ridge Tool Company as district manager. He covers the states of Missouri, Kansas, Iowa, Nebraska, Colorado, Wyoming, and Arkansas, with headquarters in St. Louis, Missouri. He succeeds James R. Graham, retired.

H. W. "Doc" Arduser, Arduser and Company, of Tulsa, Oklahoma, has been appointed dealer representative for The Hammel-Dahl Company, manufacturers of automatic control equipment.

H. W. "Doc" Arduser

Arduser is well qualified to give sound technical advice and recommendations, as well as engineering counsel on matters pertaining to installation and operation of automatic control and flow equipment.

Arduser graduated from Purdue University in 1931, majoring in Mechanical Engineering. After six years with The Pure Oil Company in material and production engineering departments, he joined Vinson Supply Company at Tulsa for ten years as sales engineer, working chiefly with the application of automatic control equipment and engineered specialties.

H. C. McClintock, who resigned recently as vice president of the land department of Sunray Oil Corporation, has opened an office at 322 Kennedy building, Tulsa, Oklahoma. He will act as consultant in land, leasing and productions in the Mid-Continent and Rocky Mountain areas.

Lovette A. Albee, 84, veteran oil well shooter, died September 20 in the Masonic home at Springfield, Ohio. A native of Alleghaney county, New York, Albee attended public schools at Bolivar and there learned to make and use nitroglycerine. He followed the oil play into Ohio and then spent a short time in Illinois and then to North Texas and New Mexico, before taking up his post in Tulsa, Oklahoma. He had charge of the shooting of wells in the Tulsa region for The Texas Company for many years, retiring when his eyesight failed.

Allison J. McNay F. C. Boler

Allison J. McNay has been appointed supervisor of a new education division of the public relations department of Standard Oil Company of California. McNay has been assistant supervisor of audio-visual aids in the Los Angeles School Department. In his new position, McNay will direct the development of petroleum educational materials for students and teachers from primary to college levels. He also will work with schools in classroom use of the Standard School Broadcast, oldest educational radio program in the United States, and Standard's motion picture service.

F. C. Boler has been appointed manager of the newly created office buildings department of Standard Oil Company of California. The new department will handle operation of all office buildings owned or leased by the company in San Francisco, Los Angeles and Bakersfield, California.

Boler joined Standard in 1922 at Spokane, Washington, as a junior salesman in a service station. Until November, 1943, he held various positions in the marketing department, and was transferred at that time to the real estate and right of way department. He has been assistant manager of this department since June, 1947.

D. J. Erikson, who started his career with Hagan Corporation as a draftsman more than three decades ago, has been elected president of Hagan and its subsidiary companies —Calgon, Inc., Hall Laboratories, Inc., and Buromin Company. He succeeds J. M. Hopwood, president of Hagan Corporation since 1918—the only man to pre-date Mr. Erikson in point of service with the company. Hopwood was elected to the new position of chairman of the board of directors of the Hagan group.

Erikson moved from the drafting board to field service and then into sales work. He helped to establish Hagan's New York office in 1920, as a service engineer, and was appointed sales manager in 1927. In 1939, Erikson was elected vice president in charge of sales, Hagan Corporation and subsidiaries.

▸ **George Randolph Ferguson** has been appointed assistant vice president of California Texas Oil Company, Ltd. supply and distribution department it was announced by W. H. Pinckard, president.

George R. Ferguson

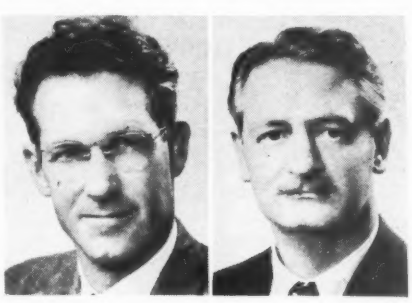
After taking his degree in chemical engineering in 1926 from Massachusetts Institute of Technology, Ferguson joined the terminal division of The Texas Company in New York.

Beginning in 1930, he was in Australia twelve years, with Caltex. From 1942 to 1946 he was on a leave of absence with E. B. Badger and Sons Company as project engineer and handled design of synthetic rubber and aviation gasoline plants; also sea water distillation equipment for the armed services.

Prior to his recent appointment, Ferguson was manager in New York of the Australasian Division of Caltex.

▸ **B. J. McMeel** recently joined Pratt Paint and Varnish Company, Dallas, as head of the oil industry division. He has had 25 years paint experience including such firms as Toch Brothers, Standard Varnish Works, and the Nu-Enamel Corporation. After many years' research and field testing work Pratt Paint and Varnish Company recently established the petroleum division to market a complete line, including such products as metal primers, exterior paints, varnishes, and several grades of aluminum paints.

▸ **J. L. Johnson** and **Robert A. Stanley** have been appointed to the technical sales staff as sales engineers of the Vapor Recovery Systems Company, it was announced by Frank B. Long, president.



J. L. Johnson Robert A. Stanley

Johnson, who has been with Varec for more than twelve years, will work out of the home office at Compton, California. Stanley will work out of the Vapor Recovery Systems Company's New York office.

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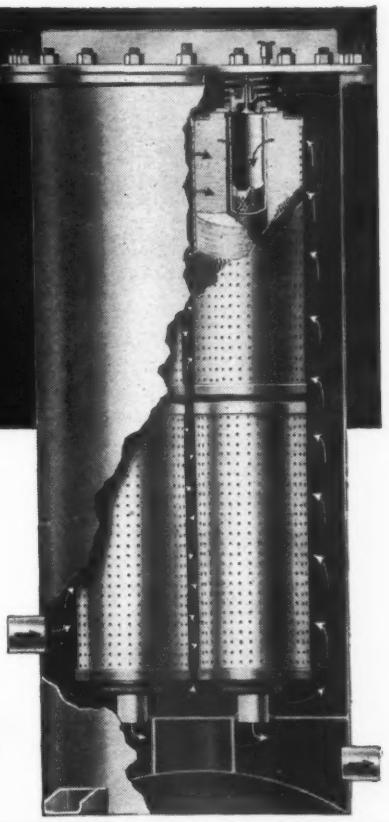

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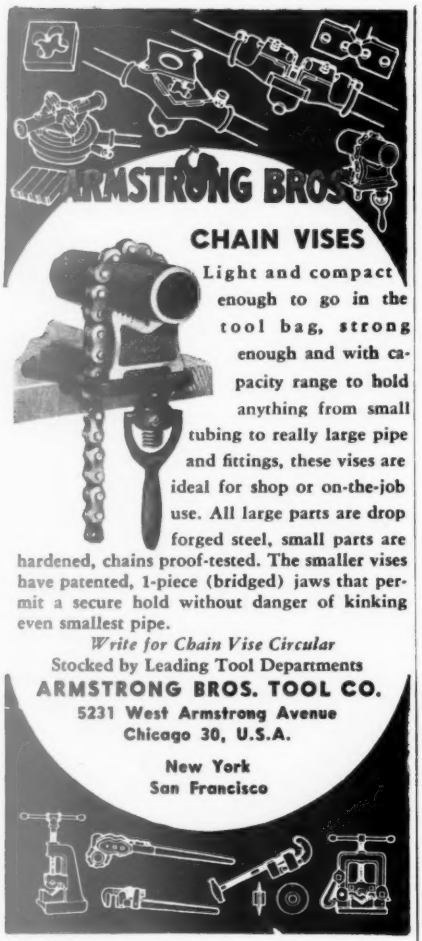
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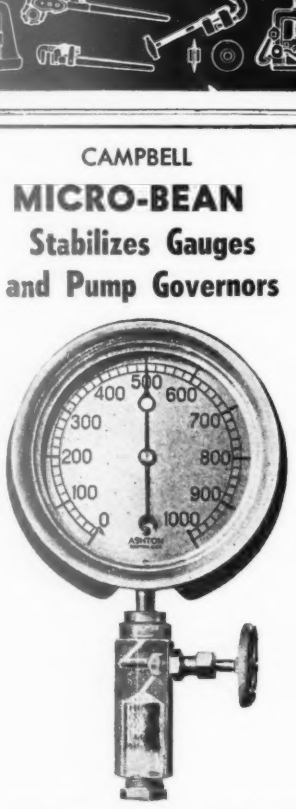

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▸ **Kirke R. Wilson,** hydraulic press manufacturer, and nationally known designer and builder of specialized automotive repair and service tools died in Detroit, September 25. He was 59 years old.

Kirke R. Wilson

Wilson made his start in the business world repairing bicycles in Arcade, New York. From bicycles he graduated to the Arcade Ford dealership. In 1913, Wilson went to Buffalo and opened a Ford part and accessory business where he invented and sold specialized tools and equipment in order to service and repair Ford cars and trucks and eventually cooperated closely with Henry Ford.

Wilson's entry into the hydraulic press manufacturing field was the direct result of building equipment for Ford dealers. KRW hydraulic presses are now being mass produced in the Arcade, New York plant.

Jack A. Ahern will assume top management of the Wilson organization with headquarters in Buffalo.

▸ **Al Bailey** has been appointed general manager of Kieley & Mueller, manufacturer of automatic control valves, it was announced by Joseph O'Connor, president. Bailey will make his headquarters at the company's plant in North Bergen, New Jersey, but in addition will spend considerable time with Kieley & Mueller distributors throughout the United States.

▸ **L. A. Pyeatt** has been appointed general sales manager of Aeroquip Sales & Engineering, Inc., distributors of flexible hose assemblies and self-sealing couplings, which recently moved its headquarters to Fort Worth. Pyeatt was formerly associated with Mid-Continent Supply Company as manager of the West Coast district.

▸ **B. L. Lerch** has been appointed factory branch manager of General Controls,, new St. Louis office, J. F. Ray, director of sales, announced. Lerch joined General Controls in 1947 as branch manager of the Dallas office. He was formerly with the Mercoid Corporation. The new office will serve the eastern half of Missouri, southern Illinois, southwestern Indiana, western Tennessee, northeastern Arkansas and northern Mississippi.

B. L. Lerch

O. D. Shaddox

O. D. Shaddox was appointed factory branch manager of the new Oklahoma City office. Shaddox joined the company in 1945 as sales engineer at the Kansas City factory branch. The Oklahoma City office will serve all of Oklahoma and all but the northeastern part of Arkansas.

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▸ **Paul Cavins,** founder and general manager of the Cavins Company since 1929, is on an extensive tour of Cavins Company and Cavins Corporation offices and service shops throughout the Mid-Continent and Gulf Coast fields. Primary purpose of Cavins' tour is to

Paul Cavins

gather on-the-job performance data of Cavins tools used in clean-out and fishing operations.

Cavins' plans are to increase the availability of Cavins tools in remote areas while at the same time standardizing the use of accessories so that virtually all bottom hole junk fishing operations can be handled in a minimum of time and expense.

Cavins' tour includes Odessa, Midland, Kilgore, Houston, and Corpus Christi, Texas, and a swing up through Oklahoma and the Rocky Mountain areas.

▸ **Ralph E. Wertz,** 72, president of the Amarillo Gas Company and chief executive officer of the Southwest Development Company died in Boston, Massachusetts, September 21. He had been executive vice president of the old Producers and Refiners Corporation at Denver, Colorado, and had moved to Independence, Kansas, when it was sold to the old Prairie Oil and Gas Company, and then to Amarillo, Texas in 1931. Wertz was a close associate of Harry F. Sinclair and considered the top aide in natural gas.

▸ **Lee J. Ledet,** Pan American Production Company foreman at Lockport, Louisiana was recently awarded the Holmes Medal and Certificate for his heroism in saving the life of Odum T. Melvin, Jr., captain of an oil barge. Melvin had been overcome by fumes in the hold of the barge and had been believed dead when Ledet arrived. Looking through the manhole Ledet believed he saw the captain move, and with only a damp handkerchief across his face for protection, he went down to rescue him.

▸ **Arthur B. Van Buskirk,** vice president and a member of the board of governors of T. Mellon & Sons, has been elected as a member of the board of directors of Koppers Company, Inc., it was announced by J. P. Williams, Jr., Koppers board chairman. Van Buskirk succeeds Donald D. Shepard of Washington, D. C., who resigned.

He is a graduate of Yale University and the University of Pennsylvania law school, and practiced law in Pittsburgh for 18 years with a law firm. Shortly after Pearl Harbor he resigned to become deputy administrator of the Lend-Lease Administration. At the end of the war he became associated with the Mellon family, and has served as vice president and governor of T. Mellon & Sons since 1946.

▸ **Robert J. Casterton** has been appointed sales representative in the Pittsburgh district sales office of the Spang-Chalfant Division of The National Supply Company, it was announced. Casterton succeeds the late William F. Hart, who died in July of this year. Casterton joined the company in 1939 after attending the University of North Carolina, and served three years with the Coast Guard during the last war.

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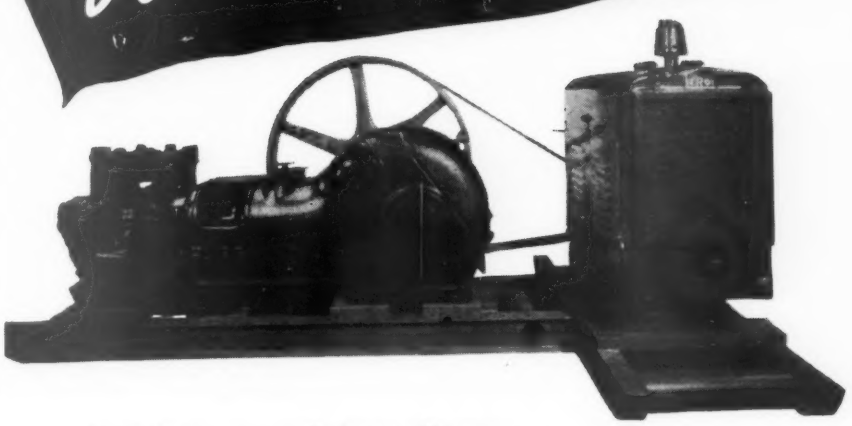

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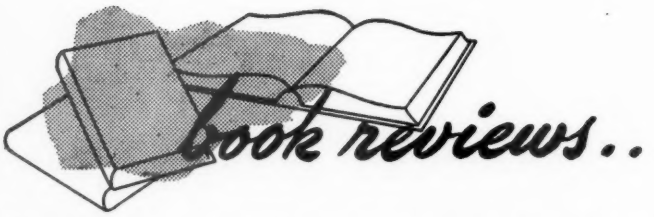


Review of Petroleum Geology in 1947. *Quarterly of the Colorado School of Mines, Vol. 43, No. 3. Pages, 334. Price, $3.*

The important events and advances in petroleum geology and petroleum geophysics as well as developments in the basic geologic sciences of interest during 1947 both in the United States and abroad are surveyed and an effort made to decipher certain trends in petroleum exploration and development procedures and techniques. Brief supplemental statistical information on production and reserves and a comprehensive classified bibliography are also included, with the activities of state and local geological surveys.

● **Chambers's Mineralogical Dictionary.** *Chemical Publishing Company, 26 Court Street, Brooklyn 2, New York. Pages, 47. Price, $4.75.*

Minerals from acanthite to zunyite, are included in this revised edition of the Mineralogical Dictionary. Forty plates show two hundred minerals in their original colors, a visual aid to identification.

The dictionary gives the concise definitions of over fourteen hundred mineralogical terms. For minerals, the chemical composition, crystal form, physical and chemical properties, occurrences, and uses are listed. Geologists, mineralogists, metallurgists, and chemists will find this volume useful.

● **Oil-Well Reconditioning in Southwestern Pennsylvania, West Virginia, and Southeastern Ohio,** *R. I. 4193, by Bruce F. Grant. U. S. Department of Interior, Bureau of Mines, Washington, D. C. Pages, 82.*

An analytical study of the methods used in oil-well reconditioning in the Appalachian area designated in the title has been published. It is part of a research program designed to evaluate means that can effectively and economically maintain present oil-production rates and make it possible to keep existing wells in operation.

Records of 1450 reconditioning jobs were studied, with detailed data obtained on 366 of the jobs. Field maps, stratigraphic charts, illustrations of equipment and numerous charts prove most helpful.

● **Physical Chemistry,** *by E. D. Eastman, and G. K. Rollefson. McGraw-Hill Book Company, 330 West 42nd Street, New York 18. Pages, 504. Price, $4.50.*

Here is a presentation of the principles of physical chemistry designed for the collegiate or the industrial chemist. The first part of the book explains thermodynamics and the properties of gaseous, liquid, and crystalline states of material systems with their accompanying formulas and derivations. Information on atomic and molecular structure, the law of radioactive decay and changes in chemical properties associated with it are clearly stated with detailed reference to the modern theories of nuclear reaction.

The second portion of the book explains the applications of the laws of thermodynamics and the electrical properties of solutions and chemical kinetics. Many other phases of physical chemistry are covered in this quick-reference book.

● **Colorimetric Methods of Analysis,** *by F. D. Snell and C. T. Snell, Vol. 1. D. Van Nostrand Company, 250 Fourth Avenue, New York 3. Pages, 239. Price, $4.50.*

This third edition on colorimetric methods far exceeds in size and scope past volumes. Due to the amount of new material, descriptions of new equipment are limited to the commercially more important types. Some unusual modifications are outlined briefly. Numerous illustrations show working principles of apparatus. The basic methods are carefully evaluated that the method best suited to the particular determination and available apparatus may be selected.

RESEARCH—GLEANING FACTS FROM FICTION

MILLIONS of dollars and man-hours are being spent every year by the petroleum industry for research and educational programs in the exploration, drilling, and producing phases of the business. These research and educational programs range from pure research on new methods of finding oil to *applied* research for increasing the recovery of crude oil from depleted reservoirs. Many companies, including service and supply companies, petroleum associations, government commissions and bureaus, universities, and many others are engaged in such programs. In fact, the conduct of every branch of the petroleum business itself involves the application of research through education.

The frequent announcements of new large scale research programs involving huge expenditures for buildings, equipment, and personnel demanding huge expenditures for buildings, equipment, and personnel so much money. Those charged with the final approval of such large appropriations may be as much in the dark about the ultimate economic value of such expenditures as the layman. Why? Because of the difficulties of predicting accurately the effectiveness of new facts that scientists *hope* to discover. Frequently, it is difficult to evaluate the scientists' findings even after they have been discovered!

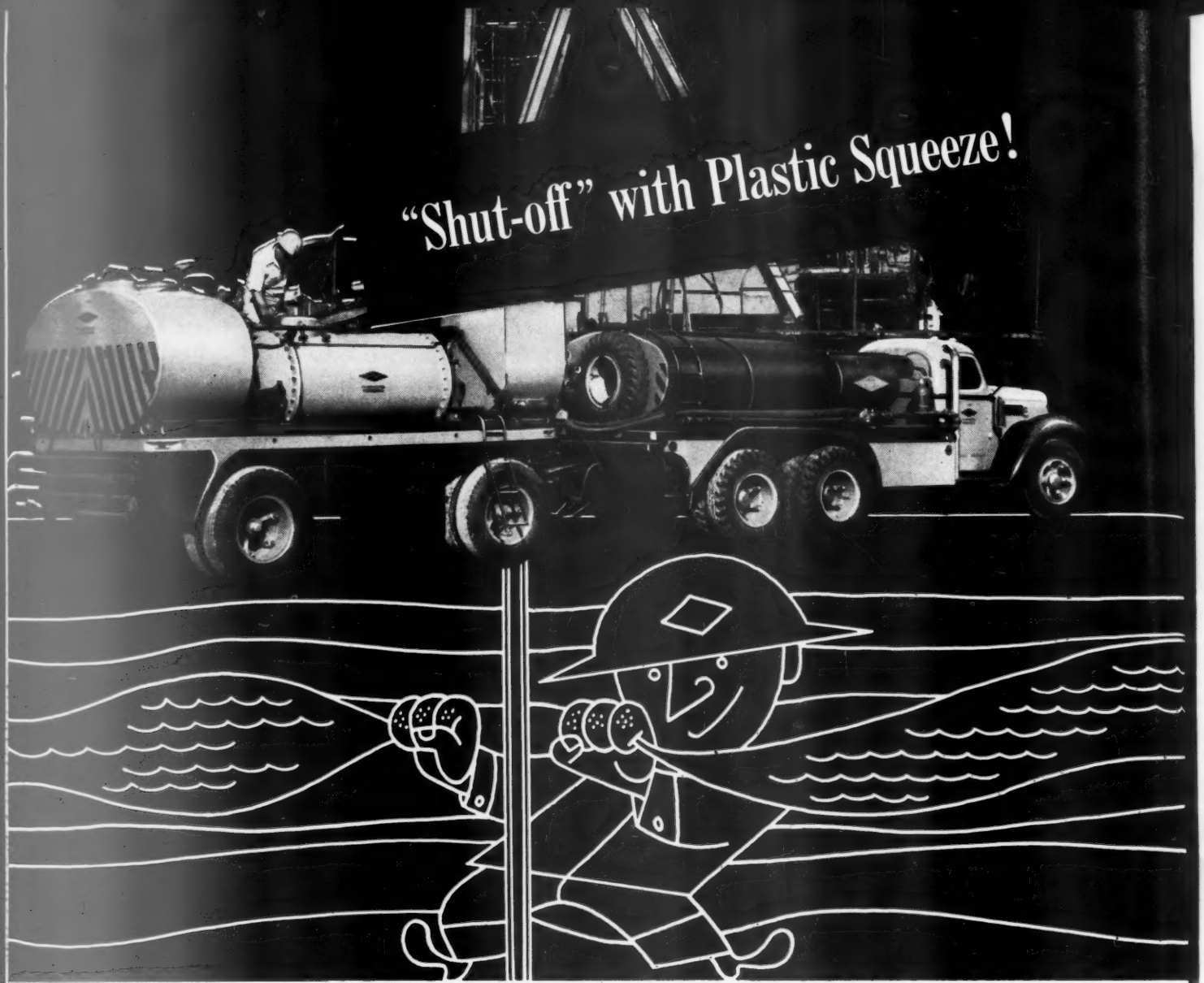
Does this chance of failure prevent us from trying? Occasionally. Most of us recognize the great progress that has been made from finding and applying new facts through research, and we welcome every opportunity we have to encourage and promote research with all the money and effort that we can spare. As a result, the finding, drilling, and production branches of the petroleum industry are moving forward on a sound footing—a scientific footing that is enabling the industry to discover and develop new sources of petroleum production and to increase the recovery from old sources—at a lower cost than heretofore, considering that dollars are now worth about 60 per cent of what they were.

Thousands of specific problems are being attacked in research offices, laboratories, and fields. The broad term, research, often covers up the real work that goes on in these places. The term might be applied to hundreds of things that are done. The dictionary defines research as (1) *a studious inquiry or examination that is usually a critical and exhaustive investigation or experimentation designed to discover new facts and their correct interpretation;* and (2) the revision of accepted conclusions, theories, or laws, in the light of newly discovered facts; or (3) the practical applications of such new or revised conclusions, etc.: also (4) a particular investigation of such a character, or a book, article, or the like presenting the investigators' discoveries.

Each of us has many opportunities to reap the benefits of innumerable research and educational programs through participation in them or a serious reading of articles about them. Research is man's way of *gleaning facts from fiction* and organizing his store of knowledge.

It is our purpose here to endeavor to provide you, the reader, with the fruits of research—and experience in petroleum problems.

K Marshall Fagin



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Analysis of Present Day Oil Well Casing Cementing Practice

By W. H. GRIFFIN, Baker Oil Tools, Inc.

FOREWORD

THIS is a report on the problems encountered and the methods currently used in the cementing of oil wells. Much of the discussion has, as a basis, the opinions and observations expressed by responsible oil men actively engaged in oil operations in North and South America.

It is universally recognized that the cementing of a well is a highly important operation, the successful completion of which involves consideration of a number of factors.

Reduction of filter-cake, mud-gel, centering of the casing, utilization of all available geological data, and close supervision of the entire cement job are necessary for obtaining successful cementation on the original casing job.

As for equipment and materials, a low-water-loss rate drilling mud, accessory equipment for centering the casing and mechanically removing the mud-cake and stirring up mud-gel, are essential elements in the successful cementing of casing.

Employment of the methods discussed has reduced the number of "squeeze cementing" jobs to a new low.

FROM the earliest days of the petroleum industry, holes drilled for oil and gas have been protected by casing. Many years ago, when pipe was first used to prevent water from coming into the well, it was found necessary to set the bottom of the pipe, or casing, in some device that would seal it to the formation. At first, this was done by means of a "seed bag," which swelled in water and made a fairly tight seal around the bottom of the pipe. Then came the logical development from the seed bag to the use of Portland cement to form a seal between the formation and the bottom of the well casing. From this humble beginning there has been a continual improvement in methods until the present. Well conditions today, formerly not conceived, require widely varying techniques to permit the effective production of oil and gas and at the same time protect the oil and gas sands in the reservoir.

In well cementing practice, cement slurry is mixed at the surface and pumped into certain places in a well, its function being to form a seal or bond between the casing and the formation. The problems encountered and procedures used in cementing casing and in the completion of wells are quite varied, and depend upon local conditions. Regular cementing procedure provides much more than a means of sealing pipe in the hole, although it frequently is apparent in the field that the variety of results that should be obtained from cementing operations are not given adequate recognition. Among the more important reasons for cementing the casing in a well are:

1. To provide a permanent shut-off.
2. To prevent corrosion, by utilizing the cement to keep highly mineralized fluids away from the casing.
3. To prevent migration of fluids from one formation to another.
4. To prevent movement of formations; the cement forming a tight seal between the wall hole and the casing.
5. To protect shallow productive sands behind the casing.
6. To protect shallow fresh water sands used for domestic water supply.
7. To protect the producing formations from upper as well as bottom water.
8. To protect the casing, where cemented, against collapse due to external pressure; and from rupture or bursting due to high internal pressures.
9. To prevent a blow-out from high pressure gas or other high formation pressures from behind the cemented casing, or other open and newly tapped zones.
10. To allow swinging the casing any distance from bottom, instead of making a seat.

Many millions of dollars are spent each year on drilling oil wells to the producing horizon. There are many essential factors that must be taken into consideration in order to assure successful placement of cement behind the casing on the original job. One of the most important operations in the entire process of drilling and completing wells is cementing the casing, and the need for exercising care in this operation is, therefore, obvious. To carry out a casing cement job haphazardly is a costly procedure for which there is little excuse. The drilling departments have carried the holes to the completion depths with the best equipment and with the best known methods. Record drilling time has perhaps been made, often under very difficult conditions, and most drilled holes now require cementing of a string of pipe. Too often in the past, when operations have reached this stage, the casing strings have been landed at the cementing depth, and the cement mixed and displaced around the casing, with but little thought given to the important individual factors that must be considered and the details to be carried out if the casing cement job is to be effective.

Today, the question of how to get an effective original cement job is receiving intelligent and continuing study by an ever-increasing number of oil companies. One company is checking all its wells drilled within the last 18 months and is placing them in classes. It began with several classifications, which later had to be increased. When all the data have been compiled, that company will be in a better position to analyze the methods that have been employed in the past, and to use such analysis as a guide in future operations. Other companies are looking at the casing cement job from angles never before thought applicable. Extensive experiments are being carried on by a few, but little research of the necessary type is being conducted.

The percentage of effective cement jobs to the number of failures does not present an attractive picture. In analyzing many of the cement failures, it is found that the cement does not completely surround the casing. This is commonly called "channelling of the

cement," and logically raises the question: Why does cement "channel?"

Cement may channel because the casing is not centered. The casing in certain places is leaning against one part of the wall of the hole. This condition may prevent the cement from encircling the pipe and forming a bond between it and the formation.

Cement may channel because the mud is in poor condition. If the mud is gelled and in an unstable state, it may permit the cement slurry to "finger" or channel through the mud, causing excessive contamination of the cement and incomplete displacement of the mud.

Most operators in North and South America recognize that the main factors causing channelling are gelled mud, mud cake, and casing that is not centered. How to keep the mud in good condition: how to reduce filter cake economically; and how to center the casing—these are the questions confronting not only the oil companies, but the oil tool manufacturers and service companies that specialize in the development of cements, muds, and accessory equipment.

As manufacturers become more familiar with the problems encountered while drilling, and the completion methods used by the oil companies, they can better develop equipment that will aid in solving some of the problems facing the industry. Some manufacturers now have engineers and experienced practical field men who are qualified to render the service required by the oil companies.

In making a selection of any one method of cementing a well, it is particularly important to take into consideration many influencing factors, some of which are more important in one area than in others, depending on the relative completeness and accuracy of available information.

Hole Problems. In some areas only small quantities of barites, clays, chemicals, or bentonite are needed in the drilling mud while drilling. In other areas the drilling mud may need larger quantities of the various chemicals and weighting materials.

There are areas in which conditions and existing well problems are similar. In parts of Eastern Venezuela, Louisiana, and the Texas Gulf Coast, problems of high pressures, gas, salt-water flows, heaving shales, temperature, and loss of circulation, are such that they vary the properties of the drilling fluid. Mud control is very important for the following reasons:

1. As certain formations are penetrated, the drilling mud must have sufficient weight to prevent blow-outs: too much weight, however, will cause loss of mud into the formation, even to the point of losing circulation.

2. A drilling mud with a high water loss can create cavities in the wall of the hole. The theory is that the shale exposed in the hole absorbs water, swells, sloughs off into the hole, and so creates cavities. Enlargement of the hole in this manner depends on the condition of the mud, the formation, and the drilling time taken to penetrate the formation. Cavities thus formed become filled with thick, viscous mud and formation cuttings. A caliper survey, which measures the cavity, will determine how much the hole is enlarged.

3. Drilling fluids that have a high rate of water loss are thick and "clabbery" on the wall of the hole. The thickness of the mud-cake and the viscosity of the mud usually depend on the temperature and permeability of the various formations penetrated.

4. The water in high-water-loss muds filters out into the sand zones, leaving a thick mud-cake on the wall. The thickness of the filter-cake, its growth, and its penetration into sands depend on the rate of water-loss. In shales, the filtration rate is very low compared with sands, but most shales tend to absorb water and slough off.

When circulation is established under conditions that cause high-gel, thick, viscous mud, and heavy filter-cake, the drilling mud will tend to move through the channels of least resistance. As cement is discharged from the casing shoe, it usually travels upward in the annular space between the casing and the wall of the hole. The mud toward the center of the hole is probably less viscous than the mud on the wall and so will be the first to be replaced by the cement during its upward course. The combination of off-center casing, poorly conditioned mud, and the existence of cavities usually permits the cement slurry to be exposed to mud contamination and to flow upward in irregular channels. This results in portions of the casing being exposed to the formation instead of being entirely encased in the cement.

Why are the original cement jobs in some areas more effective than in other areas? Many believe that it is the result of not having to use excessive amounts of specially prepared muds, colloids, and mud chemicals. Wells drilled relatively straight and in areas where the formations are hard (parts of West Texas, California, Colorado, Oklahoma, Illinois, Western Canada and Western Venezuela) are known to have fewer casing cement job failures. In checking these areas, it is found that their mud problems are relatively few and the formations are relatively hard.

Drilling fluids largely are responsible for hole enlargement and excessive filter-cake. If there are cavities and other irregularities in the hole, the annulus will be exposed to channelling and contamination when the cement is placed. A hole with fewer irregularities would possibly permit a higher percentage of cement to be placed in these cavities and with less contamination. In the opinion of most field men, mud-cake prevents the cement from forming a bond to the formation. Many believe that the use of a low-water-loss mud or its equivalent is a step in the right direction for the reduction of filter cake, hole cavities, and thick viscous mud. Some companies are reducing the water-loss rate of their muds to 6 cc. or less be-

THE AUTHOR

W. H. Griffin was born in Saratoga, Texas, and studied petroleum engineering at University of Houston. His initial oil field work was with Standard of California on roustabout and production gangs around Huntington Beach during high school vacation days. Later was employed by various oil companies and drilling contractors, as rotary helper, derrickman, and driller. Joined Baker Oil Tools, Inc., early in 1936 as service engineer, and graduated through a series of responsible positions to that of export division service engineer, which he now holds.

During the war Griffin did some highly specialized work on cementing and dual completion in Venezuela and Trinidad, and recently made a return trip to Venezuela on another important assignment involving well completion practice. He is a member of the Houston Club, Houston Technical Club, API, AIME, Houston Foreign Trade Association, and Nomads.

fore drilling into the zones in which the well will be cemented. The lower the water-loss rate of the mud, the better the conditions wil be for an effective cement job. Companies that are using low-water-loss muds are getting a high percentage of effective cement jobs. It is recommended, as one of the factors in better cement jobs, that the water-loss rate of the drilling mud be kept as low as economically and safely permissible.

Geological Information. All available geological information, particularly that obtained from ditch cuttings, formation cores, electrical surveys, and caliper logs, should be studied and utilized.

A careful study of the electrical survey and other data will make it possible to determine the approximate desired weight of the cement slurry; whether a percentage of bentonite should be added to the cement; and the correct placement of the specialized accessory equipment on the casing.

Some holes have low pressure zones in which circulation is reduced or lost. Cement of the same weight as that used in high-pressure areas usually will not cement the casing satisfactorily to the required height in low pressure areas. Sometimes the admixture of a small percentage of bentonite, or similar material to the cement will reduce the column weight and give the needed consistency. The proper use of precisely installed multiple cementing equipment will usually result in effective placement of the cement to the required level.

In many areas the producing zones do not have a shale zone between the oil zone and the water or gas sands. Some companies report cement job failures despite all the precautionary measures taken beforehand. In other areas, however, wire scratchers and centering devices have resulted in satisfactory completions. Faced with these conditions, many operators follow the practice of "squeeze" cementing before production tests.

Many companies now use all the available geological and other data on the character of formation penetrated. By so doing, they are getting better cement jobs. Those with whom this factor in cementing was discussed are unanimously in favor of using all available geological data. They realize its importance in the completion of an effective cement job.

Cement and Procedure. In cementing wells, consideration must be given to many factors including the size of the hole, the size of the casing to be cemented, temperature and pressure, and other such conditions in the hole. To determine what cement and what slurry composition should be used for a given cement job, it is necessary to know the time that would normally be required for mixing and placing the slurry. The hydrostatic pressure and bottomhole temperature play an important part in selecting the kind of cement to be used.

Many improvements have been made in recent years by manufacturers of cement. Today, the industry can choose a cement to fit almost any individual well problem, regardless of temperature and pressure conditions in the well. Cement is available in a range and variety of characteristics sufficient to enable the operator to exercise considerable personal judgment in their selection.

Slow-set cement was developed initially for use in deep, high-temperature wells. Cement that can be pumped for a long period before it begins to set is believed to be well adapted for use in deep wells of high temperature. Cements now available are satisfactory from this standpoint. Some operators use a slow-setting cement for all their casing cementing so as to take advantage of the additional weight (reduced water-cement ration) that it provides. Intelligent selection of cement for a particular job and the careful preparation of a slurry to meet the well conditions will do much to insure an effective casing cement job.

Sometimes it is beneficial to use bentonitic and other special materials to prevent the loss of cement into the formation. Mixing the cement slurry to as heavy a weight as can be pumped safely will reduce contamination. Reducing the weight of the cement slurry increases the water-cement ratio. Some slurries may not reach the required height, the weight of the slurry being such that it will go into the formation. In such cases, weight of the slurry is reduced, and it is considered good practice to add a small amount of bentonite (not more than 2 per cent) to the cement slurry. Frequently, this will still give the necessary consistency, and the weight of the slurry will be such that it will reach the required level without difficulty.

It is known from actual experience that fluids of a greater viscosity will usually displace a liquid of lesser viscosity and that a fluid of lesser viscosity will "ring-tail," or pump through, a fluid of greater viscosity. Thus, when cement of poor consistency comes in contact with high colloidal mud, the mud becomes viscous and causes the cement to pump through portions of the mud, and to channel. To help prevent gelling of the mud, it is considered good practice to circulate after the casing is landed until circulation and returns are free.

Some operators prefer to run a "spacer" between the mud and the cement slurry; other operators are experimenting with various ideas, including a slug of bentonitic cement of the regular slurry. Although there still are some operators who think that a spacer is not necessary, the consensus is that the use of some kind of a spacer is a step in the right direction.

Experience with the use of calipers to survey the hole has revealed that the original size of the hole made by the bit varies with the formation penetrated. It has been found that the diameter of the hole drilled in shale is much larger than that drilled in sand. High-water-loss muds are assumed to be the main factor contributing to this difference. It is considered good practice to run the gamma, caliper, and temperature instruments on the first few wells drilled in an area, or in the completion stages of wildcats. From the information thus obtained, the amount of cement to use in future wells drilled in that area can then be determined.

In areas where caliper logs have been in use, it has been found that on the average the volume of the annular space plus 25 per cent will bring the slurry close to the calculated levels, unless channelling occurs. Temperature surveys and the gamma log, using carnotite in the cement, provide a good check on the height of the cement level.

The relationship between the size of the casing and the size of the hole affects the placement of the cement. When the inside cross-sectional area of the casing is about the same as the cross-sectional area of the annular space between the casing and the formation, the fluid or cement descending in the casing will have about the same velocity as the fluid ascending in the annulus.

Some operatiors think that movement of the casing in a perpendicular direction while cementing is a good procedure, whereas others think it does more harm than good. Of course, there is the danger of sticking the pipe while it is out of place, but some think it safe to work cautiously until a drag is indicated, at which time they position the pipe in the correct spot.

A few companies rotate their casing. The use of various accessory equipment on the casing may make it necessary to work the pipe up and down as well as to rotate it. This would depend on the nature of the accessory equipment placed on the casing. Hazards encountered in the movement of casing during cementing are being reduced as experience increases.

It seems to be the general opinion that, after the cement slurry has been placed, the best policy is to defer subsequent operations until the cement attains sufficient strength to insure the complete, permanent shut-off desired. In formations of high temperature this waiting period is much shorter than in formations of lower temperature. It is thought also that after the cement has attained sufficient "shut-off" strength (though not its ultimate strength), it is a relatively softer state and can be drilled out without danger of its being fractured.

Specialized Accessory Equipment. Benefits are being gained by the use of wire scratchers, centralizers, centering equipment, side-opening whirler shoes, multiple cementing equipment, and "bottlenecking" the hole with the use of the wall scraper. Results are being recorded about such equipment each time it is run. Improvements are continually made by the manufacturer to meet the constantly changing conditions as the depths of wells increase.

Centering Devices. 1. WIRE SCRATCHERS: There are three types that are being used: The rotating type, the reversible type, and the horizontal type.

The *Rotating Type Scratcher* is designed to operate, after it has been placed in proper position on the casing, by the rotation of the casing. Its purpose is to remove mud cake and clean the face of the formation so that the cement can form a secure bond. The Rotating Type Scratcher is being used by a number of operators, but definite results are difficult to establish. In a survey of scratcher jobs, it was found that 66 per cent of the jobs were successful.

It should be observed that:

(1) In placing scratchers on the casing joints while the latter are still on the pipe rack, sufficient space must be allowed on each end to provide the room needed for the rotary table, casing slips or casing spider, spinning rope, and casing tongs. As some types of scratchers cannot be placed on the pipe before running, precious time may be lost in installing them while the pipe is hanging made up in the derrick.

(2) After the scratchers have been installed on the casing joints at the pipe rack, ample space on the pipe rack must be provided for each joint so that the scratchers will not be damaged while waiting for drilling operations to reach a point where casing is to be run.

(3) Special preparations must be made for rolling the scratcher joints off the pipe rack, on to the walk, and into the derrick without damaging the scratchers.

(4) It may not always be possible to rotate the pipe after reaching setting depth. A check showed that about 8 per cent failed to rotate. Sometimes the pipe stops rotating before the cement is completely displaced; but, in most cases, circulation continues, and the rest of the cement is displaced behind the casing.

Other points to be noted about the use of Rotating Scratchers are:

(1) The problem of stocking a number of sizes is eliminated, because one size fits all sizes of casing.

(2) As the scratchers do not wipe a full 360 deg while going in the hole, there is less danger of sticking the pipe.

(3) As the functions of the scratchers have no bearing on the perpendicular movement of the pipe, the correct setting depth is maintained during the whole operation.

No trouble is noted while running in the hole, and the scratchers, while being rotated, indicate that they are effectively removing the mud cake. They seem to have little centering effect on the casing. The benefits offered by scratchers of this type warrant their continued use. Some operators believe that the use of centering collars, or special centralizers, in conjunction with the scratcher, may prove to be beneficial.

The *Reversible Type Scratcher* is so designed that it can be installed on the casing in opposite directions to eliminate any tendency of the casing to rotate while running in. It removes the filter cake and breaks up gelled mud when the casing is moved up and down.

One company reports having used wire scratchers and centralizers on a total of 30 wells. Of these, two became frozen during the progress of the job, but most jobs were considered effective. On three of them, however, the wells came in making water, and even after being squeezed were still making the same percentage of water.

Another company and its subsidiary, reporting together on the basis of more than 100 completed wells, and estimate having obtained about 70 per cent more successful cement jobs by this method than by any other. They also report that in one difficult field 80 per cent of the jobs were successful with the use of wire scratchers and centralizers. Before they began using them, wells in the area had to be squeeze cemented. One company reports that, in many cases, it has been necessary to squeeze the section of the casing where scratchers and centralizers have been spotted opposite the upper zone. Now, this company usually squeezes the upper zone before a production test.

In South America, as well as in North America, it has been observed that the hazards first encountered have largely been overcome by experience and improved technique. Wells using wire scratchers and centralizers are much harder to perforate, depending upon the size of the annulus between the casing and the wall of the hole, and, in some cases, must be reperforated a number of times.

The *Horizontal Type Scratcher* is a straight type that removes mud-cake from the walls of the hole when the casing is worked up and down. The design is such that the scratcher wipes the walls of the hole on the downstroke of the casing and on the upstroke tends to remove mud-cake.

More than 2500 wells have been completed with this type of scratcher in the last 8 years. Few actual figures are available, but it is reasonable to believe that a large percentage of these jobs proved effective. One company reports that, although it generally obtained effective cement jobs by this method, the method was not effective under all well conditions.

In the opinion of some engineers, the Horizontal Type Scratcher pulls too much mud-cake off the walls at one time. A few companies report that after trying these scratchers they changed to other methods because of trouble with sticking the pipe. This may have been due to a lack of experience and proper supervision.

Another company that has used this type of scratcher on a number of jobs, reports it has had no trouble getting the casing to bottom initially or during the cement job and believes this method has reduced squeeze jobs 25 per cent.

This type of scratcher has been used for the most part without centralizers, but some companies are now adding centralizers to the casing, and report that the combination of the two is more effective.

Another operator is using this scratcher in conjunction with centering equipment and whirler shoes. He states that the casing goes in the hole much more easily than before and reports all cement jobs in the difficult area to be effective.

Probably the one biggest difficulty in using either the Reversible Type or the Horizontal Type of wire scratcher is the danger of sticking the casing while it is out of position. A number of companies that set pipe through the producing zone, drill 30 to 60 ft more hole than is normally necessary By doing this they are assured that the casing shoe is always below the pro-

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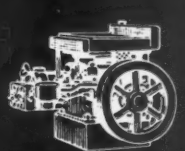

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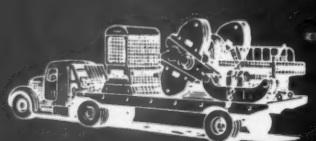

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ducing zone during the movement of the casing.

Wire scratchers are poor centering devices, but the use of wire scratchers in combination with centralizers or centering collars is recognized as a valuable aid in successfully cementing the casing. The primary functions of wire scratchers are to remove mud-cake left on the walls of the hole by the drilling mud, and to mix mud gel, so as to insure a bond between the cement slurry and the formation with a minimum of contamination and channelling.

2. CASING CENTRALIZERS are designed mainly to hold the casing off the walls of the hole. When properly installed, centralizers aid in placing a uniform body of cement around the casing, and tend to reduce channelling.

There are two principal types of centralizers: the *straight* type and the *spiral* type. Both types are made so that casing can be rotated without damage to the centralizers. The consensus among operators seems to be that both types accomplish the same objective.

A number of oil men believe that the centralizer goes well with the wire scratcher, and this combination of centralizers and wire scratchers has been used on a great many wells. Comparative data are not always available although a number of companies report that this combination is giving a high percentage of effective cement jobs and that results seem to warrant its continued use.

3. CENTERING EQUIPMENT. This equipment is designed with a larger O.D. than collars on the casing. For example, when using 5½-in. O.D. casing in 9-⅞-in. drilled hole, centering equipment having 7¾-in. or 8½-in. O.D. is specified. This means that the casing whirler centering shoe, centering float collar, and plain centering collars, that fit 5½-in. O.D. casing, all have 7¾-in. or 8½-in. O.D. The number of plain centering collars placed in the casing string depends on formation data.

The 7¾-in. O.D. centering equipment is being run successfully in 8⅝-in. drilled holes. A few strings of 7-in. O.D. casing have been cemented in 9⅞-in. drilled holes with 9-in. O.D. centering equipment.

Centering shoes and collars tend to center the casing joints and hold them away from the walls of the hole. Plain centering collars have the same I.D. as the casing on which they are installed.

It is reported by one company that in the past 7 years it has used 5½-in. centering equipment with 7-¾-in. O.D. in 5 different fields on a total of 78 wells. In each field, different geological conditions existed in the producing areas. The fields ranged from 5500 ft to 10,000 ft in depth. While drilling, this company followed the practice of using a low-water-loss mud. Usually, as the depth of the drilled hole reached the horizon in which they wanted to obtain effective cement jobs, the water loss of the mud was dropped to 6 cc, and in some areas to 3 cc. A 9⅞-in. hole was drilled in most instances, but a few holes were drilled with an 8⅝-in. bit. As many as 10 extra centering collars were used on one string of casing, the number being determined on the basis of available geological data. On all completions, the casing went into the hole without any trouble and it is reported that every job was effective.

On many of the completions, however, where geological data indicated it to be desirable, the practice was followed of squeezing at the gas-oil contact or water-oil contact before production tests. It was noted that these wells were much harder to squeeze. It was not certain that the wells needed squeezing, but, rather than take chances, the surer procedure was followed of squeezing before completion. Some of the wells were completed successfully without squeezing before a production test. In a number of these completions, it was hard to determine whether the centering equipment was actually responsible for the successful cement jobs. Nevertheless, it was noticed that companies drilling and completing wells on offsetting leases without using centering equipment had to squeeze many of their wells.

One company is using 8½-in. O.D. centering equipment on 5½-in. O.D. casing and setting it in a 9⅞-in. drilled hole. The entire producing area is provided with centering collars, and a few horizontal-type wire scratchers are placed between the centering collars. A low water loss mud is used and the entire cement job is closely supervised. The wire scratchers are not worked until the cement has started out of the casing shoe, and the casing is worked for only a few minutes while the cement is being displaced around the producing horizon. The principal reason for working the wire scratchers is to break up the mud-gel. This company has completed 8 wells in two different fields with depths of about 2900 ft and 9200 ft, and reports no cementing failures. As a basis for comparison, another well drilled in the same area where centering equipment had previously been effective, used only regular cementing equipment. This latter well has a high gas-oil ratio.

Another company, now drilling its 12th location in a field where the producing reservoir is at a depth of about 8500 ft, has used centering equipment on all wells, and reports all cement jobs to be effective.

Still another company, which has completed 126 wells drilled in two different fields during the last 6 years, reports that each well has been completed with centering equipment installed on the casing. It considers all its casing cement jobs as successful. This same company reports that recently, six years after completion, the gas-oil ratio is increasing slowly in a few of these wells and that water is encroaching in some of the edge wells. It believes, however, this is due to geologic conditions in the reservoir.

Many companies in a number of other fields have used centering equipment. In all, about 500 wells have been completed by these companies with the use of centering equipment.

During the cementing, the centering collars have a tendency to hold a back pressure on the fluid in the annulus. It is assumed that the back pressure so created will tend to make the fluid move as a body, thus reducing the opportunity for the cement to channel or to become contaminated.

Experimental work is now being carried on with fluted-type centering equipment having perpendicular grooves placed at 120 deg intervals. By grooving in this manner, the outside diameter can be increased without unduly restricting the annulus between the centering collar and the wall of the hole. Twenty jobs have been completed at depths of as much as 10,000 ft, and it is reported that the casing went in the hole very easily in each instance. All 20 jobs were successful.

The success of centering equipment is believed to be due mainly to the fact that the casing is centered within the range of the centering equipment's O.D. Because of the large O.D. of the centering equipment, the velocity of fluid is increased around the collars while the casing is being lowered in the hole, and the resultant washing action tends to break up mud-gel and helps wash filter-cake from the formations.

It is assumed that the increased circulation area obtained with the fluted grooves causes greater fluid circulation around the centering collars while going in the hole, thus reducing the hazard of hole-bridging conditions. It is thought that by using fluted centering equipment larger outside diameters can safely be run in the hole. Users of centering equipment report that no trouble has been experienced while using it, and that many successful cementing jobs are being obtained by its use.

Side Opening Shoes. A number of years ago various types of side-opening cementing shoes were designed to provide circulation when the shoe was set on bottom and could not be raised with safety, or where holes were tight at the bottom and there was a possibility of shutting off circulation. The jetting action of the earlier side-opening shoes was thought to be too severe on most formations, causing the formation to crumble and slough, and often defeating the purpose of the side-opening type of shoes.

The whirler shoe was designed to reduce or eliminate such troubles. It whirls the fluid around the shoe, causing a desirable washing action. The whirling of the fluid helps reduce the hazards of channelling by enabling the fluid to encircle the casing. The earlier whirler shoes had baffled side ports that directed the fluid upward. When occasion required, however, baffled side ports that directed the fluid downward were used for removing bridges and facilitating the landing of long strings of casing. It was learned that the whirling action was not changed in any way, despite the greater turbulence created at the shoe.

Jones and Berdine* report that:

"The mud cake was removed from the walls of the hole only over the area covered by the travel range of the down-whirler shoe. From this comparison, the jetting action of side ports in the down-whirler shoes appears to have considerable value in mud cake removal." They also state that two known methods are effective in removing mud cakes: The first, by using suitable mechanical devices on the casing, such as "scrapers and scratchers"; the second, through "hydraulic action by direct impingement of fluid jets (such as that induced by down-whirler shoes) against the walls of the hole."

Although the general opinion among field men is that the whirler shoe is effective at the shoe, opinion regarding its effectiveness above the shoe seems to vary considerably. Removing mud-cake for considerable distances with the whirler shoe is sometimes done by working the casing over as much area as possible. Whirler shoes are also used in conjunction with wire scratchers, centralizers, and centering equipment.

Side opening shoes are beneficial to casing cementation. It is considered desirable to use them with other accessory equipment to reduce channelling and contamination of the cement.

*P. H. Jones and Denis Berdine, spring meeting, Pacific Coast District, API, Los Angeles, California, March 19, 1940—report on "Oil Well Factors Influencing Bond Between Cement and Formation."

Multiple Cementing. There are several different kinds of specially operated cementing collars.

The special cementing collar, when placed at carefully predetermined positions in the casing, is used in placing cement around the pipe for an extended distance above the shoe or any designated cementing point in the well.

Multiple cementing jobs are being executed by two-stage and three-stage methods. In a few cases, where more stages are needed, series cementing collars are used.

(1) *Multiple cementing with Series Collars* is used for special types of cement jobs. In areas where difficult problems are involved, Series Cementing Collars are used effectively in conjunction with cementing baskets and centering devices. This method is not recommended unless those using the equipment thoroughly understand the functions of the various pieces of the equipment and the job involved. They must be willing to sacrifice the time element. It is also imperative that careful preparation, accurate measurements, and related calculations be made. Experienced "well men" with seasoned "know-how" should supervise the entire cement job.

In a survey covering fields of North and South America it is noted that for a total of 49 wells completed by this method, 185 series collars were used. These jobs had a cumulative total of 334 exposed fluid ports of which 39 had to be recemented when tests revealed that they leaked. In other words, repairs were required on about 12 per cent of the exposed fluid ports.

(2) *Multiple cementing by the two-stage method* consists ordinarily of cementing the first stage around the shoe and the second stage through the two-stage cementing collar positioned at a desired point above the casing shoe.

When a two-stage collar has been placed in a string of casing, usually the cement for the first stage is pumped in followed by a flexible cementing plug, or special plug; or by displacements until the cement has been displaced to the desired position; or the cementing plug seats on the float collar and shuts off. After the two-stage cementing collar as been opened, the cement is pumped into the casing in the usual manner, followed by the regular cementing plug, and then pumped to a shut-off.

An increase has been noticed in the number of wells completed with this equipment during the past year. A check was made covering a number of areas in which an aggregate of some 300 wells had been completed by this two-stage method. Of these, 81 per cent were effective and did not require recementing of the fluid ports in the collar.

Included in this check were groups of wells that showed no failures. In other groups the degree of success was only 50 per cent, while still other groups had 80 per cent effectiveness in shutting off all the fluid ports on the original cement job.

Many companies test these fluid ports by pressure test. In some cases, as much as 3000 psi pressure is held against the fluid ports for 30 min. others test with packers.

(3) *Multiple cementing by the three-stage method* is carried out in about the same manner as two-stage, but with the addition of a second cementing collar and an extra cement job using the flexible plug.

There have been 16 wells completed by the three-stage method in the West Texas area. Seven of the 32 collars had to be recemented. This makes an average of about 78 per cent effectiveness in closing off the cementing ports during the original cement job.

As more experience is gained with multiple cementing practices, cement will be placed with greater accuracy at the required levels. More and more the various companies are utilizing all the essential factors that go to make an effective cement job. No single item can be credited with successfully cementing a string of pipe, it depends on a combination of factors.

Most of the mechanical difficulties that were first encountered have been reduced to a minimum and each job can be expected to function in a normal manner. Most of the companies using multiple cementing equipment have found it to be an economical method in areas where it is needed, even though about 20 per cent of the fluid ports require recementing. Some of the users state that the percentage of success could drop as low as 50 per cent and the multiple methods would still be a profitable procedure.

"Bottlenecking." This is a term widely applied to enlargement of the hole by means of a wall scraper at and above the point where the shoe of a string of casing is to be placed. The thick cement anchor plug thus obtained adds to the effectiveness of a job. The wall scraper is generally used to enlarge the hole at strategic points. Wall scraping has a tendency to remove all the old mud-cake from the walls of the hole and leave virgin formation exposed. Circulating fluid employed during the wall-scraping procedure should have as low a water-loss rate as is economically feasible without danger to the well.

Removing old mud-cake from the walls of the hole is believed to be beneficial, and use of a low-water-loss

mud during the scraping job will leave a very thin filter cake. The depth of the cut to be made by the wall scraper for mud removal will depend on well conditions. Some operators scrape only to the original gauge of the bit, thus removing only the mud-cake from the formation.

Opinions are varied about the effectiveness of the hole enlargement, some being for and others against the practice. It is recognized that the relationship between the size of the annular hole and the size of the casing has a bearing on the successful placement of the cement.

Contamination and channelling can be reduced if the cross-sectional area of the inside of the casing is about equal to the cross-sectional area of the annular space between the casing and the open hole. When the casing can be landed and cemented with a ratio approaching one to one between the annular and casing areas, the chances of a successful cement job are greatly enhanced. Wells are being cemented successfully with a ratio of about 1 to 2, but frequently wells cemented with ratios approaching 1 to 3 have to be recemented.

When the ratio of the casing area to the annular area is about 1 to 1, the fluid ascending in the annular space around the casing will have about the same velocity as the fluid descending in the casing. This velocity should be sufficient to cause the fluid or cement to move upward around the casing as a uniform, continuous body or mass. It is assumed, of course, that the rate at which the cement is mixed and pumped will be in accordance with usual field practice.

The rate at which the fluid or cement is pumped down the casing may be varied to obtain the desired velocity in the annular column ascending around the outside of the casing. If the ratio of the cross-sectional area of the casing to that of the annulus is less than 1 to 1, for instance, then an increase in the pumping rate would tend to compensate for the difference. Many original casing cement jobs, involving a casing-to-annular area ratio as low as 1 to 3 have been effective when the casing has been centered with centering collars of large diameter.

As many effective cement jobs are being obtained today with the 1 to 1 ratio, there is a simple working formula for determining the casing or hole size required to approximate this ratio:

$$D = 1.41\ d$$

Where: D is the diam of the hole, d is the O.D. of the casing.

Thus, if we have 7-in. O.D. casing and want to determine the hole size (D) required to give us a casing-to-annular area ratio of about 1 to 1:

$$D = 1.41\ d$$
$$D = 1.41 \times 7\text{ in.}$$
$$D = 9.87\text{ in.}$$

that is, a 9⅞-in. hole will give a ratio of about 1 to 1 when 7-in. O.D. casing is used.

"Bottlenecking," for short distances in the proper places, and where the hole enlargement is not too great, is generally considered an aid in centering and effective cementation of casing. Wall scraping is believed to help remove the mud-cake and leave the formation face clean for the cementing job.

▸ **Conclusions.** An ideal cement job would be one in which cement is placed completely around the casing to form a bond with the formation for a predetermined distance up the annular space in the hole, without contamination or channelling.

Each influencing factor should be given careful consideration to insure that it will do its part in contributing to the successful completion of the cement job. The neglect of even one factor may spell the difference between success and failure in obtaining a satisfactory cement job.

Full consideration of the following points should contribute to the effectiveness of an original cement job:

PREPARATION—Consider, check, and study, all available geological data and also information on the drilled hole to be cemented.

SUPERVISION—Provide for complete supervision during all phases of the cement job.

LOGGING—While the use of appropriate logs is desirable in any case, in all wells where experimental work is involved, the hole caliper log and the temperature or gamma log always should be used for comparison of the results of the cement job.

MUD—Use a drilling mud with a low water-loss rate, a mud that will tend to reduce hole enlargements, filter-cake thickness, and gel strength.

CONDITIONING HOLE—Break up mud gel and remove filter cake with wall scrapers, wire scratchers, or other appropriate equipment. "Bottleneck" with a wall scraper where deemed advisable.

CASING-TO-ANNULUS AREA RATIO—Determine that the casing-to-annulus area ratio is within recommended range.

PROPER EQUIPMENT—Check all surface and accessory equipment, making sure that the right amount and kind of equipment and materials are at hand. (This should be based on conclusions reached after study of geological data and information regarding the hole as described under PREPARATION). It should be borne in mind that certain cementing shoes tend to remove bridges and facilitate landing of long strings of casing, cause a desirable washing action, and help eliminate hazards of channelling. It is well to remember also that, in general, multiple stage equipment is both advantageous and economical where the geological data indicate the need for multiple cementing.

PLACING EQUIPMENT—Place all accessory equipment so that it is in proper correlation with the formations penetrated and other well data.

CENTERING CASING—Center casing by using centralizers or using centering equipment that will provide maximum centering force when in cementing position in the open hole, and that will still permit the safe landing and cementing of the pipe without difficulty.

CEMENT—Use the lowest possible water-cement ratio within the consistency range suitable to meet local well conditions. The consistency should be such as to permit placement of the cement slurry to the required level by movement as a full body in the annulus, with a minimum of contamination and channelling.

These in summary are the important factors that must be taken into consideration in each well.

It goes without saying, of course, that taking all these precautionary measures will not necessarily insure a fully effective water and gas "shut-off." The extreme variations in hole conditions, formations penetrated, and differential pressures within the reservoir preclude absolute infallibility even when known approved methods are used. In many wells in which unfavorable conditions predominate even "squeeze cementing" methods have not entirely overcome the problem.

The improved technique of cementing wells, developed by experimental work, has resulted, however, in a noticeable reduction in remedial "squeeze jobs." It is logical to assume, therefore, that the observance of all the accepted precautionary measures, as covered in this report, should assure a better and more effective cement job than would be obtained should any or all such measures be neglected.

▸ **Acknowledgement.**

The author wishes to express his appreciation to all personnel in the oil industry in North and South America who have so generously contributed their opinions and their valuable suggestions on well problems and methods, in the preparation of this paper.

* * *

Baash-Ross News

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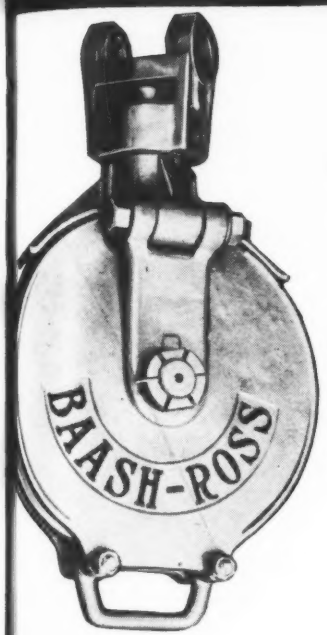
OUR 28th YEAR



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Although in average drilling and producing operations there are dozens of different jobs that call for small blocks, you can reduce them all into three principal types of work . . .

1. **Bending lines around corners, such as in snatch-block applications.**
2. **Supporting lines in the rig for lifting tools and equipment.**
3. **Small traveling block applications for reducing line loads during hoisting operations.**

And the Baash-Ross Universal Utility Block is unique in that, simply by changing inexpensive accessory units, this *one* block will handle any of these *three* types of jobs. What's more, its capacity is 39 tons with 2 to 1 safety factor!

For example . . .

FLOOR BLOCK: Simply attach a base plate and you have a Floor Block that can be used with portable pulling outfits in well servicing work. Positive stops allow the Block to tilt 45° in any direction and a roller bearing swivel allows it to follow the line freely as it spools on and off the drum. To save time, in moving the Block from rig to rig, you can anchor an inexpensive base plate on each rig floor and quickly mount the Utility Block by inserting just one anchor bolt between plate and Block.

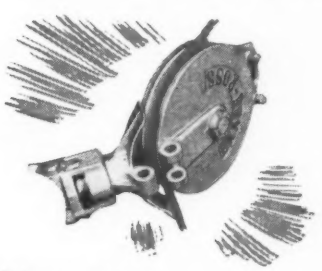
CORING BLOCK: When you need a small block in the crown for handling bailing and coring lines, simply attach a beam hanger unit to the Utility Block, fasten the beam hanger to a crown beam and you're ready to roll.

The hanger can be placed at any convenient point on the crown beam and when tightened, will not slip. The full-swiveling and tilting features permit the Utility Block to follow the line freely, minimizing wear on both line and sheave.

TUBING BLOCK: Fasten a tubing block clevis and your Utility Block is ready to serve as a Tubing Block in a wide range of well servicing applications. The clevis is free to swing from side to side and is also free to rotate . . . or can be locked against rotation by means of a built-in pin. The heavy-duty tapered roller bearing on the sheave gives the unit a high working capacity.

HEAVY DUTY *Performance Features*

Three-way adaptability is only part of the story on the Utility Block. Look at these top quality construction features . . .



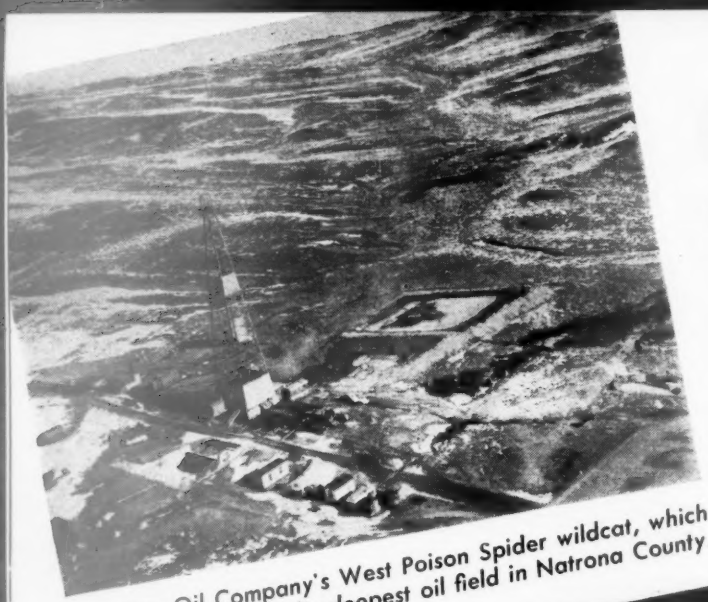
- Side opening feature (by simply removing one bolt) saves time in placing lines around the sheave.
- Capacity 78,000 lbs.—with 2 to 1 safety factor.
- Sheave is alloy steel, 18" dia.—with flame-hardened groove 14½" dia.
- Bearings in both sheave and swivel are heavy-duty tapered roller type.
- Full 360° swiveling in all applications—or swivel may be locked by built-in pin.
- High pressure grease ducts direct to sheave and swivel bearings.
- Rope cannot jump sheave—guarded by side plates.

The Baash-Ross Universal Utility Block makes important savings on small-block inventories and it is available grooved for any line from ⅜" through 1".

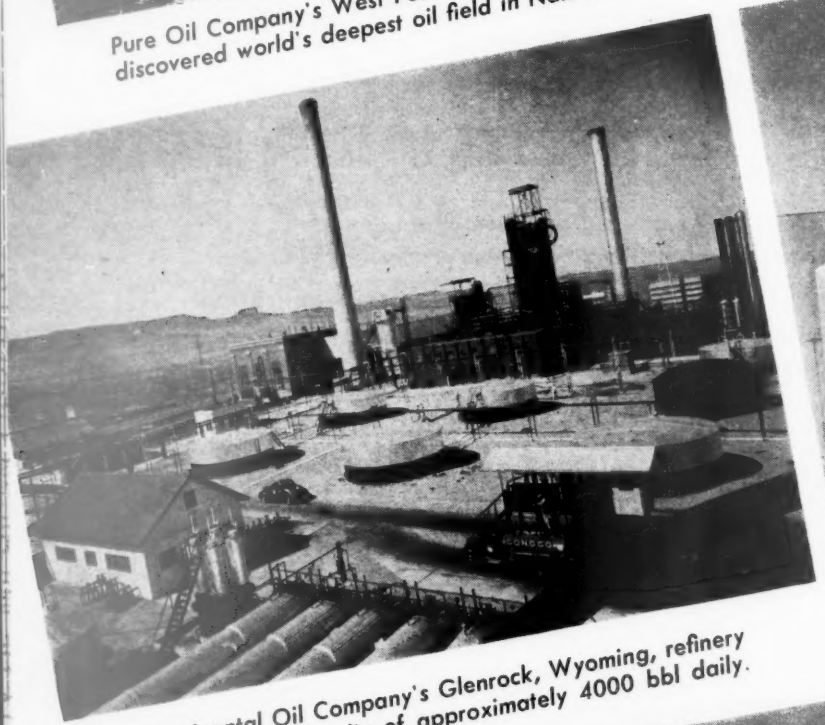
AVAILABLE THROUGH LEADING SUPPLY STORES

WYOMING

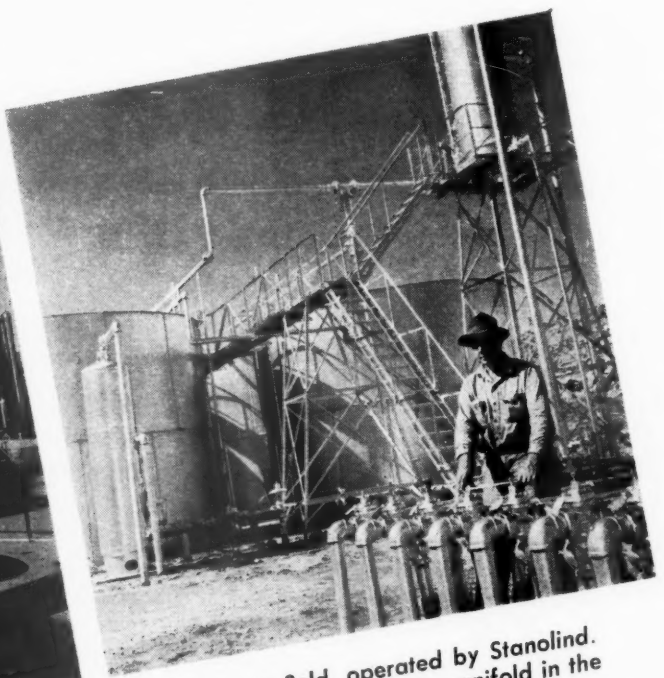
Photogenic Wyoming presents a fascinating panorama of oil operation scenes. Dazzling skies and great sweeping basins rimmed with craggy mountains provide a background to delight photographers. The oil companies mentioned in the various captions supplied pictures used here.



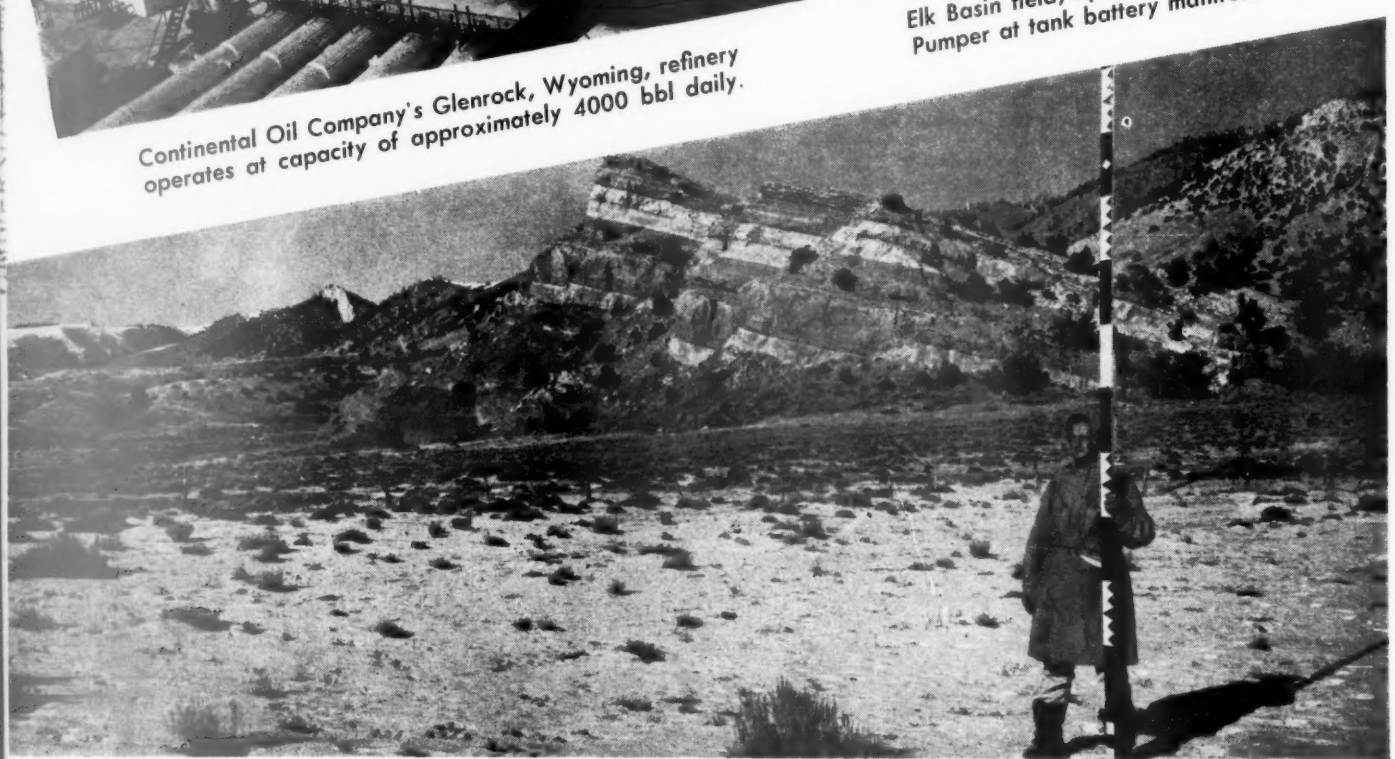
Pure Oil Company's West Poison Spider wildcat, which discovered world's deepest oil field in Natrona County.



Continental Oil Company's Glenrock, Wyoming, refinery operates at capacity of approximately 4000 bbl daily.

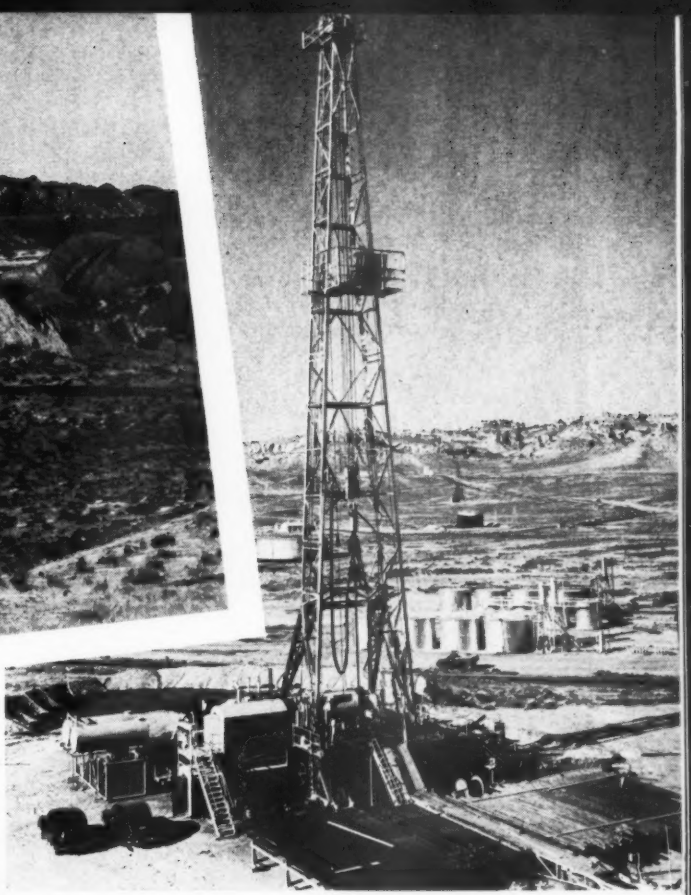


Elk Basin field, operated by Stanolind. Pumper at tank battery manifold in the



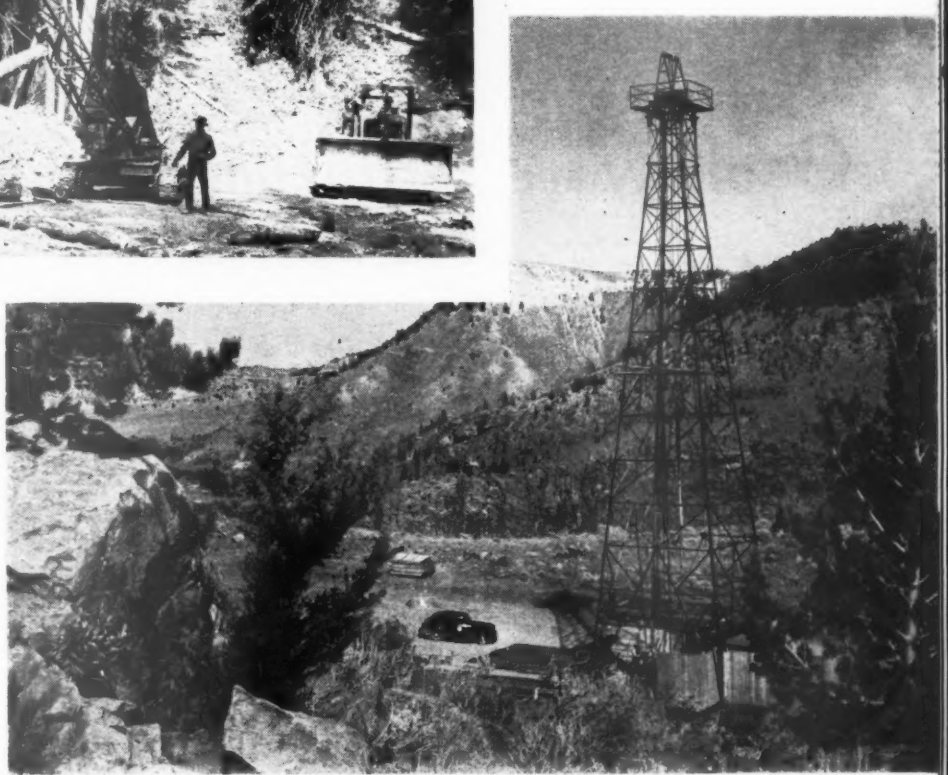
Rodman of Carter Oil Company geological mapping party, standing against a background of Chugwater sandstone on the Madden Anticline, 80 miles north of Lander, near the Owl Creek Mountains.

Plane table operator in front of jagged structure of Sun Dance limestone in Owl Creek Mountains.



A portable drilling rig in the Elk Basin field, which is operated under a unit agreement by Stanolind Oil and Gas Company This is one of 92 unit agreements in effect in Wyoming.

Roads to new wildcats are one of the heavy expenses of exploratory operations in Wyoming. The road above was built to a Stanolind location at Spread Creek, in the Jackson Hole region, Teton County. One of the most beautiful spots in the nation, it nevertheless presents a typical Wyoming road problem for wildcat locations. On a mountain side, it had to be built to carry heavy equipment for deep drilling.



View of Circle Ridge field, Fremont County, where Continental has 21 wells with daily production of about 2400 bbl. The field was discovered in 1923.

Photo courtesy Continental Oil Company

Geophysical crew on the move in Little Sand Draw near Geho field, northwest of Casper, Wyoming

Geology and Petroleum Resources of Wyoming

By HORACE D. THOMAS, State Geologist

WYOMING is one of the oldest oil-producing states, yet the last few years have brought about renewed exploration and development on a scale never witnessed before. The first producing oil wells were drilled in Wyoming in the 1880's. Although the famous Salt Creek field was discovered in 1908, the state did not become an important oil producer until 1913, in which year about 2,300,000 bbl of oil were produced from 4 main fields. In 1947, about 43,000,000 bbl were produced from about 4200 wells in about 80 fields, the state ranking seventh among the oil-producing states. There were 7 fields whose individual production in 1947 each exceeded that of the entire state in 1913.

Twenty-five new fields, discovered in the past 5 years, contributed over 8,000,000 bbl of oil to the 1947 production, and deeper pays discovered since 1942 in old fields helped raise Wyoming's production from 33,000,000 bbl in 1942 to 43,000,000 in 1947. The 1948 production will exceed the banner year of 1923, when over 44,000,000 bbl of oil were produced, New fields and new pays continue to be found.

From many vantage points in Wyoming, rocks representative of the five major eras of geologic time may be observed. The state has a remarkably complete rock sequence, and sediments representing all but one of the periods of post-Proterozoic time are exposed at the surface. These sediments, of Paleozoic and later age, rest upon an ancient basement complex composed of various sorts of igneous and metamorphic rocks of Archeozoic and Proterozoic (pre-Cambrian) age. The ancient crystalline rocks, although not oil-bearing, are of interest in petroleum exploration because their nature, attitude, and nearness to the surface must be considered in geophysical ex-

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ploration. Furthermore, there are suggestions that the structure of the younger oil-producing rocks may be related to, or controlled by, features of the basement complex.

The eras and periods of post-Proterozoic geologic time are shown in Fig. 1. The ancient Archeozoic and Proterozoic eras are omitted. Each era is divided into periods. On the chart, the Silurian period, which intervenes between the Ordovician and the Devonian, has been omitted since the Silurian is not represented in Wyoming. Eras and periods are world-wide time units.

Locally, rocks deposited during the different periods are divisible into units called formations, the formations being discriminated on the basis of their physical features and fossil content. The formations shown in Fig. 1 represent a compiled sequence made up of the best known formations, although the sequence given is essentially characteristic of many parts of the state.

In Fig. 2 can be seen the distribution of Paleozoic rocks in Wyoming.

▸ **Geological structure.** Structurally, Wyoming is made up of major anticlinal folds that are the present mountain uplifts, and intervening synclinal depressions that are the present intermontane basins. The major structural framework was outlined by the Laramide folding, with slight modification and uplift of a regional nature during Cenozoic time.

The mountain uplifts are asymmetric anticlines with one gently dipping flank and one steeply dipping flank, which may be overturned or thrust faulted. The direction of overturning and thrust faulting varies in the different ranges. The mountains of westernmost Wyoming differ from those to the east in that they are fundamentally a series of low-angle thrust blocks in which the pre-Cambrian rocks are not exposed, as they are in other mountains. The intermontane basins are large downwarped areas that in themselves are made up of minor anticlines and synclines. They, too, are generally asymmetric and the deepest structural part of most basins lies fairly close to one of the bounding mountain uplifts.

The minor structures lying within the basins are anticlinal and synclinal folds that may be concentrically arranged around a basin, as in the Big Horn Basin, or may parallel a mountain front, as along the west margin of the Laramie Basin, or may trend at an angle to the axis of a mountain range and plunge off into the basin obliquely, as in the Wind River Basin. The minor anticlines are usually asymmetric, with one flank of moderately low dip and the other of steeper dip. On the steep flank of strongly asymmetric anticlines, beds may stand vertically or be overturned. This type of structure is commonly characterized by a high-angle thrust fault on the steep flank. Some anticlines may be fairly broad, or open, whereas others may be very narow and tightly compressed. Some are essentially unfaulted, but others are characterized by numerous radial normal faults. Others show normal faults transverse to the anticlinal axis, dividing the structure into a number of individual units. The normal faults commonly die out with depth so that deeper horizons are unfaulted. The Elk Basin anticline is marked by dozens of normal faults that displace the Frontier sands and control accumulation in them, but none is known to extend deep enough to displace the Tensleep, some 3000 ft deeper. Conversely, thrust faults seem to have their greatest displacement at depth and to die out upward. Wells drilled on some anticlines that appear unfaulted at the surface have passed through thrust faults at depth.

In earlier years there was considerable conjecture regarding the nature of the central parts of the basins, since the central parts are masked by relatively undeformed Cenozoic sediments. The marginal folds, exposed where Cenozoic rocks have been stripped back from the mountain fronts, were very apparent but there was little evidence to indicate whether the central parts of the basins were simple downwarps or whether they were characterized by minor anticlines as are the marginal parts. Seismic exploration indicates that the central parts of the basins have been folded to such an extent that anticlines present are adequate for the trapping of commercial oil pools.

▸ **Oil producing horizons.** A peculiar philosophy has existed in Wyoming in respect to possible oil-producing horizons. It held that there was

FIG. 1. Table showing standard geological time, representative formations in Wyoming, and oil-producing sands.

ERA	PERIOD	FORMATION	OIL-PRODUCING SAND
CENOZOIC	QUARTERNARY	GLACIAL DEPOSITS	
	PLIOCENE	NORTH PARK	
	MIOCENE		
	OLIGOCENE	WHITE RIVER	
	EOCENE	WASATCH	WASATCH SANDS
	PALEOCENE	FORT UNION	
MESOZOIC	CRETACEOUS	LANCE	
		MONTANA GROUP	SHANNON SAND
		NIOBRARA	
		FRONTIER	FRONTIER SANDS
		MOWRY	
		MUDDY	MUDDY SAND
		THERMOPOLIS	
		CLOVERLY	DAKOTA & LAKOTA SANDS
	JURASSIC	MORRISON	
		SUNDANCE	SUNDANCE SAND
	TRIASSIC	CHUGWATER	
		DINWOODY	
PALEOZOIC	PERMIAN	PHOSPHORIA	PHOSPHORIA LIME (EMBAR)
	PENNSYLVANIAN	TENSLEEP	TENSLEEP SAND
		AMSDEN	DARWIN SAND
	MISSISSIPPIAN	MADISON	MADISON LIME
	DEVONIAN	DARBY	
	ORDOVICIAN	BIG HORN	
	CAMBRIAN	GALLATIN	
		GROS VENTRE	
		FLATHEAD	FLATHEAD SAND

rope takes a beating like this, you ought to check the application"

"The foreman on this job was blowing his top. He was already behind in production when this machine went down. He swore that the wire lines were no good.

"We took a look at the sheaves. They were badly worn. Then I asked him, 'When did you check those grooves?' Nobody on the job could remember when the sheaves had been regrooved.

"We got out a gage. Sure enough, that's where the trouble was. The grooves had worn down so that the proper size gage nowhere near bottomed. Now they're regrooving and I sold him on the idea of letting me check all his equipment. I'll bet we keep his business and his lines will give twice the service."

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little use in drilling wells deeper than certain formations. Although some of the first oil produced in the state came from the Tensleep and Phosphoria, those formations were not looked upon with favor because the crude was low-gravity black oil. Oil found in the Cretaceous sands in the early days was high gravity green oil, and the Cretaceous sands were consequently extensively developed. In a general way, then, the Cretaceous sands came to be looked upon as constituting the "deepest commercial production." Fields were drilled no deeper than the producing Cretaceous horizons, and wildcats were abandoned after testing the Cretaceous sands.

Although Sundance oil had been known for 10 years, it was not until 1935 that the Sundance came into its own as a producer with the completion of a 3000-bbl well in the basal Sundance sand in the Lance Creek field. This resulted in a flurry of deeper drilling to the Sundance in old fields and of the redrilling of unproved anticlines to test the Sundance, giving rise to many new deeper discoveries in southeastern Wyoming and to Sundance discoveries in anticlines that had proved barren in the Cretaceous sands.

Phosphoria-Tensleep production was widely distributed over the northwestern part of the State, mostly in shallow fields, but in general the oil was too heavy and sulphurous to be of great value. Many fields were discovered and shut in. Circle Ridge, for instance, was discovered in 1923 but not developed until 1941. In January, 1943, however, a well drilled to the Tensleep at Elk Basin flowed 2400 bbl of 30° gravity oil, and this seemed to be the necessary stimulus to start a campaign of deepening old fields all over the state to the Tensleep and of redrilling previously barren anticlines in which the Tensleep had not been tested. This resulted in the discovery of many deeper pays in old fields and in the discovery of new fields, with the surprising disclosure that not all Phosphoria-Tensleep crude is low gravity. Phosphoria crude at Worland proved to be 40° gravity; Tensleep crude at Medicine Bow proved to be 61° gravity. High gravity Phosphoria and Tensleep crudes have been found in many other fields.

Since 1942, the tendency has been to test units below the Tensleep, with encouraging results. The Darwin sand, at the base of the Amsden, has proved to be a new pay in several fields. The Madison lime, which long was given little attention, now produces in a dozen or more fields. Even the Cambrian rocks, at the base of the section, which were once thought to offer no possibilities, have been proved for commercial oil production.

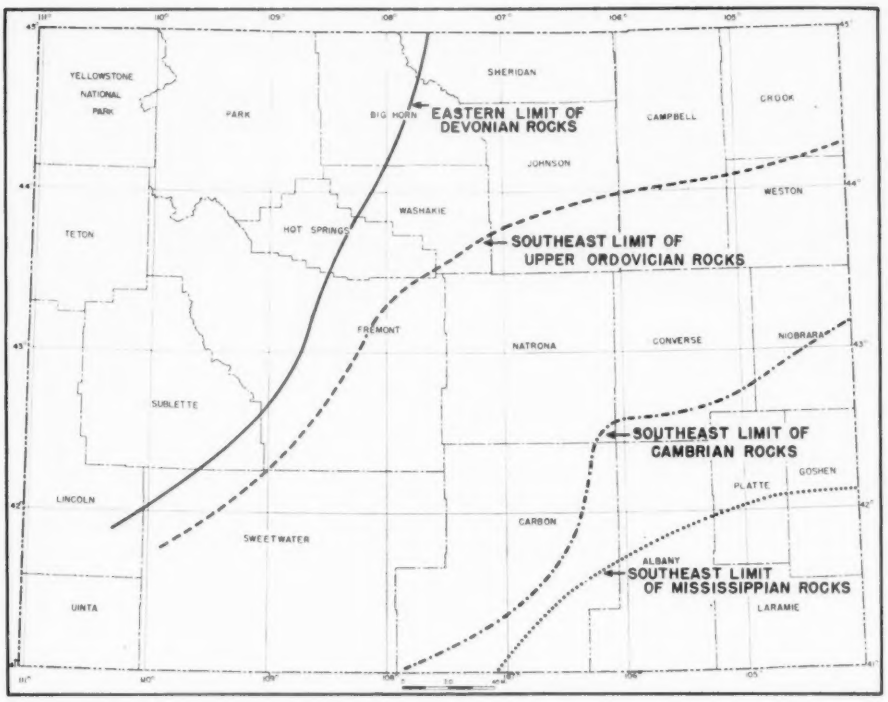


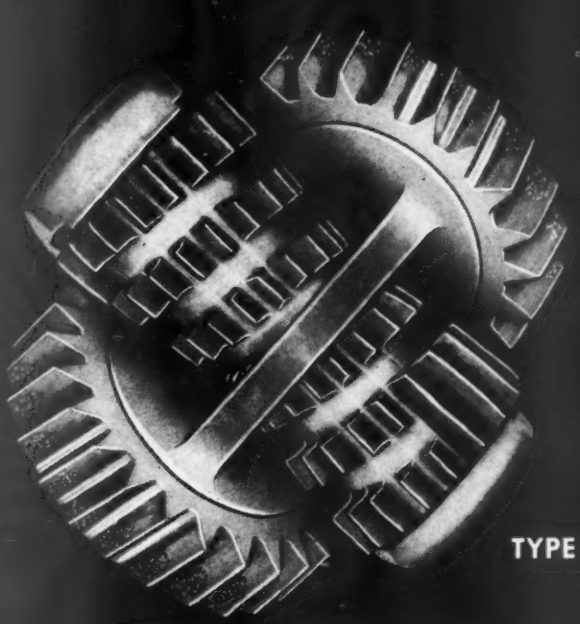
FIG. 2. Map showing distribution of Paleozoic rocks in Wyoming. Silurian rocks are absent; Pennsylvanian and Permian rocks are present throughout state.

Whereas in earlier days, there were regionally "deepest possible producing horizons," it appears today that no anticline can be considered completely tested until a well has been carried to the pre-Cambrian rocks, and that the total potentialities of a field can not be determined until a well has been drilled to the basement complex.

Cenozoic rocks.—The Cenozoic rocks over much of Wyoming have not been looked upon with favor as oil producers because of their non-marine origin. Some small uncommercial wells produced some oil from the Oligocene rocks near Douglas and near Shawnee in central Wyoming, but the oil and gas certainly originated in other rocks and migrated into the Oligocene rocks. Main production from Cenozoic rocks lies along the Wyoming-Colorado border, south of Rock Springs, Wyoming, where oil and gas are produced from the Wasatch formation in the Hiawatha and Powder Wash fields. Oil also is produced from the Wasatch in the Labarge field in westernmost Wyoming. Some gas is found in Eocene rocks in the Green River and Great Divide basins, and this part of the state, at the moment, appears to offer the best possibilities for the discovery of new petroleum or gas reservoirs in the Eocene rocks.

Mesozoic rocks.—Sandstones in the thick Cretaceous section have been the state's best producers of high-gravity paraffin base oil. Although some gas has been produced from the Mesaverde formation, the highest producing sand of Cretaceous age is the Shannon sandstone. Oil was produced from the Shannon sand in the old Shannon pool, on the north plunge of the Salt Creek anticline, down dip from the outcrop, in 1894. The Shannon sand, however, has not been an important producer and there is but one field of any size, Cole Creek, which produces from this sand. The sandstones in the Frontier formation, commonly known as the Wall Creek sands, produce over wide areas in central and northern Wyoming, the main production in the Salt Creek field being from the Wall Creek sands. Many old important fields produce from these sands and new Frontier discoveries have been made in recent years. The Muddy, Dakota, and Lakota sands, at the base of the Cretaceous section, have produced oil and gas for many years. These sands are productive in all parts of Wyoming.

The Jurassic rocks are oil producers in southeastern Wyoming. Some oil is produced from sands in the Morrison formation, but Sundance sands are important producers in many fields lying in a northeast-southwest trending belt parallel with the old Sundance shoreline. The Nugget sand produces oil in



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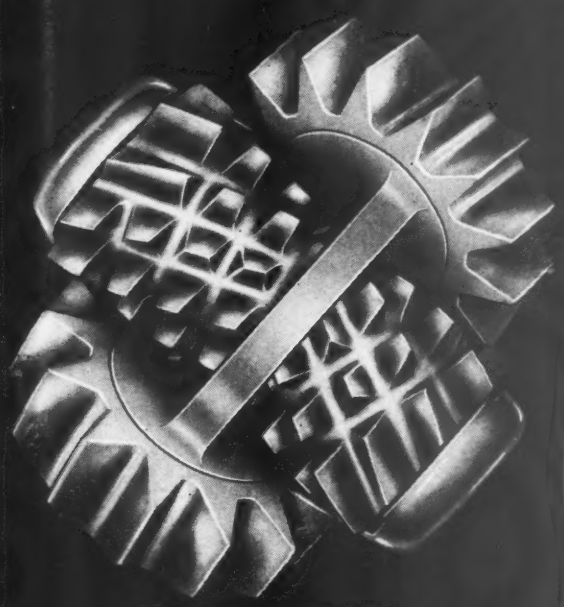

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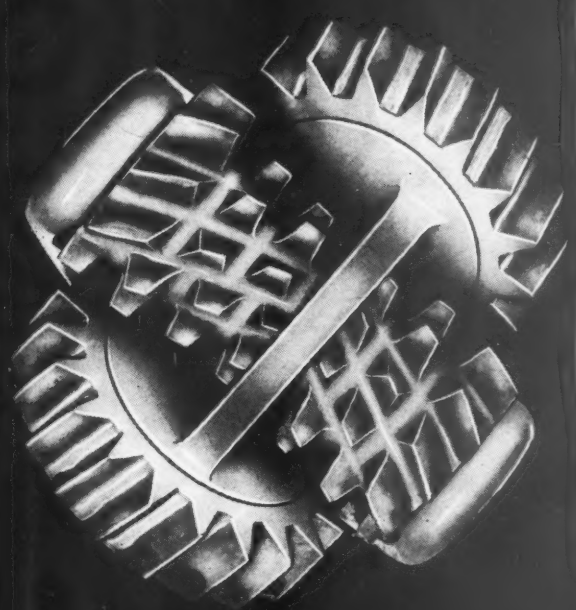

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the Steamboat Butte field, outside of the belt of ordinary Sundance production, but it seems that the oil is not indigenous to the Nugget and is migratory from older formations.

Triassic rocks are not important oil producers in Wyoming. Some heavy black oil has been produced from the Chugwater in some of the old fields in the Lander area and in the Thermopolis area.

Paleozoic rocks.—The Phosphoria formation produces much oil in the Wind River and Big Horn basins from dolomites in the marine facies. To the eastward, in the area where the Phosphoria is replaced by redbeds equivalent rocks are barren. The shallowest Phosphoria production is at Circle Ridge, in the Wind River Basin, where the formation produces from a depth of around 600 ft (plus 6500 ft, sea level). The deepest Phosphoria production is at Worland, in the Bighorn Basin, from a depth of 10,000 ft (minus 6000 ft, sea level).

The Tensleep sandstone is a prolific oil producer in the Big Horn and Wind River Basins, in the Lost Soldier district, and in the Casper area. The Tensleep (Casper) produces in the Laramie Basin, and the equivalent Minnelusa is productive in the eastern part of the Powder River Basin. Some oil has been known from the Amsden in the Big Horn Basin for over 20 years, but during 1948 production was established in the Darwin sand at the base of the Amsden in the Lost Soldier and Wertz fields. Many fields in the general region have not been tested below the Tensleep and the Amsden offers possibilities for production in adjacent fields.

The first Madison production was developed in the Frannie field, on the Wyoming-Montana border, in 1929. Madison oil was also found in the nearby Garland field in 1930. It was not until 13 years later, however, that commercial Madison production was found in another Big Horn Basin field; at Oregon Basin in 1943. In 1946, the Madison lime was found productive in the famous Elk Basin field and the first Madison oil was found in the Wind River Basin in the Circle Ridge field. In 1947 and 1948, Madison production was developed in the Lost Soldier and Wertz fields in the Rawlins area. The important point is that this formation, which 5 years ago was known to be an oil producer over only a very limited area, has now been proved productive almost across the state from north to south.

No oil is at present produced from Devonian or from Ordovician rocks. These beds have been penetrated by a number of wells and the results so far have been negative.

Cambrian oil was discovered in the summer of 1948 when a well in the Lost Soldier field flowed 720 bbl of 34.5° gravity oil from the basal Cambrian sandstone, only a few feet above the basement complex. Shows of oil had been obtained in Cambrian rocks at two other localities, but since so few wells have penetrated these beds, their ultimate productive area and possibilities remain uncertain.

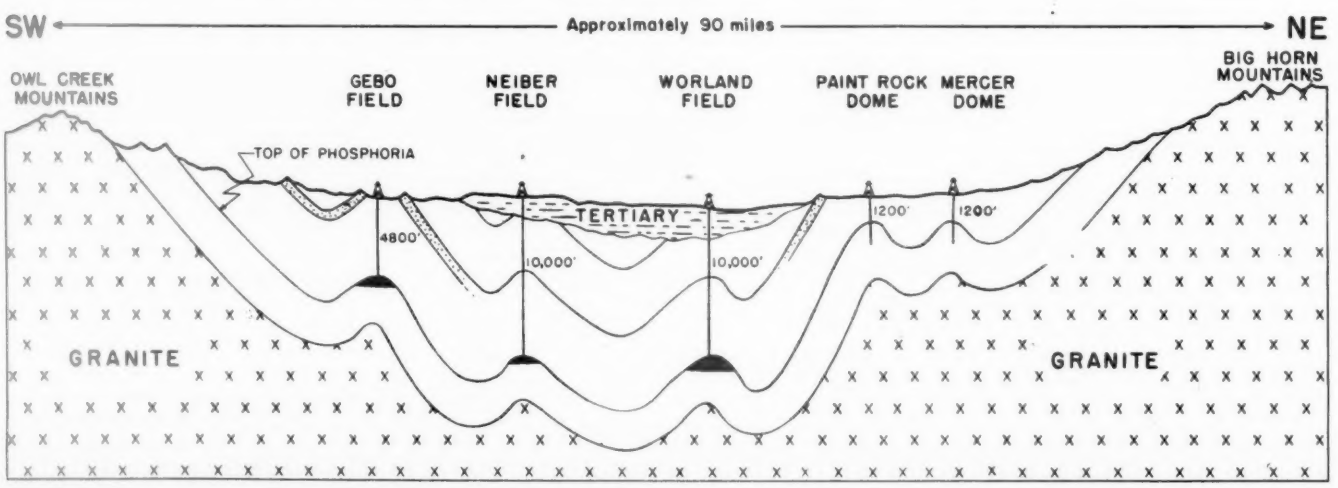
Mode of accumulation. Essentially all of Wyoming's oil production comes from the conventional anticlinal trap. Closed structures may or may not produce oil. Some structures with a large amount of closure have, so far, proved barren. Other structures with a relatively small amount of closure have proved to be prolific producers. In many anticlines, only one sand may be productive whereas in others essentially every pervious bed will produce. In the Lost Soldier field, for instance, there are 14 producing horizons.

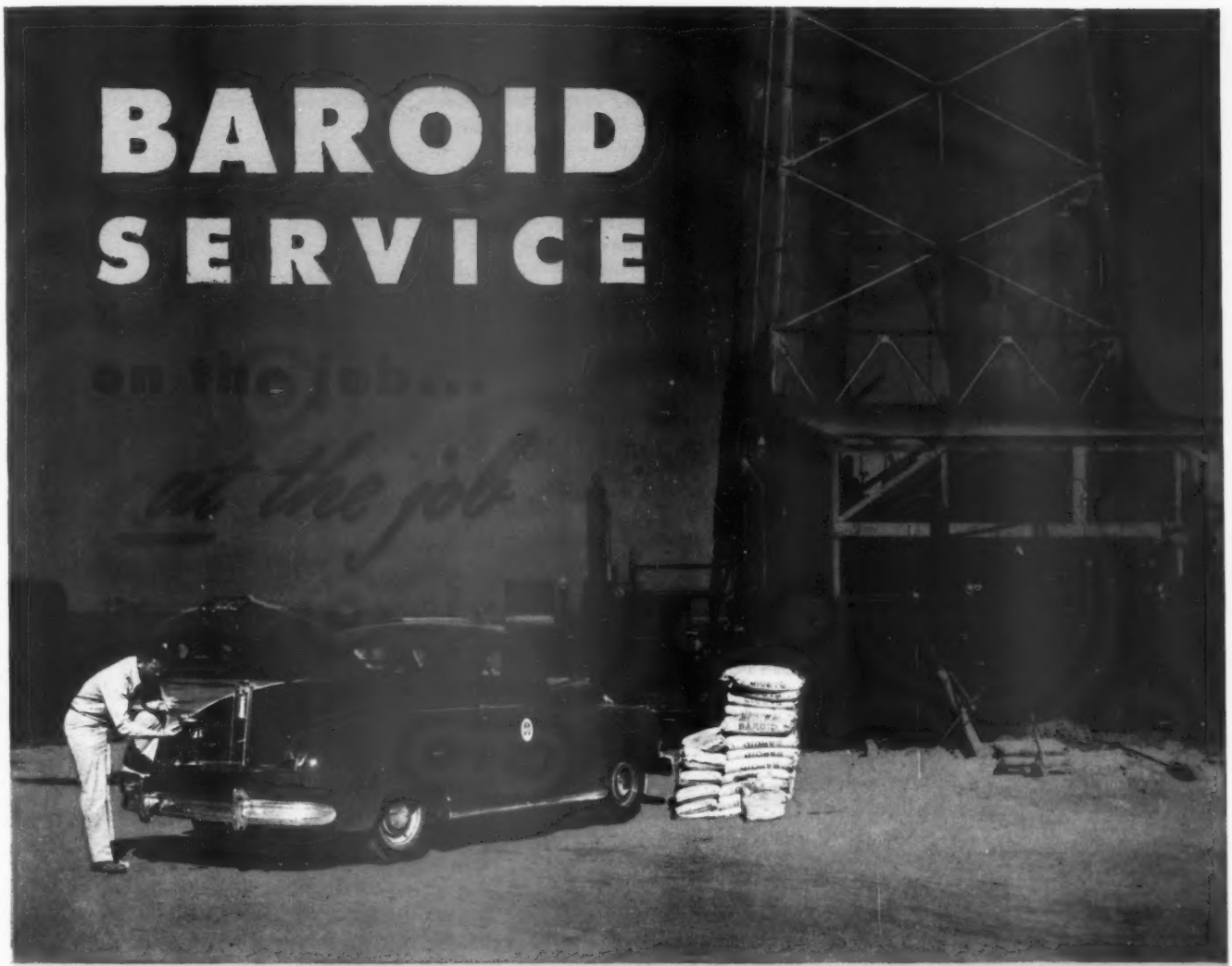
In general, none of the anticlines is completely filled with oil and the water table lies part way down the flanks of structures. In addition, the size of the area over which different sands produce in a multiple-zone field is extremely variable. In the Salt Creek field, for instance, productive acreages are as follows: First Wall Creek, 2500 acres; Second Wall Creek, 20,500 acres; Lakota, 2100 acres; Sundance, 920 acres; and Tensleep, 1000 acres. In the Elk Basin field, the Second Wall Creek sand produced from 500 acres; the Tensleep produces from 5000 acres.

Fault traps have not been important producers, except where individual fault blocks have acted as units along anticlinal axes, in which case accumulation is actually primarily controlled by anticlinal structure, with faulting being a subsidiary factor. Some new fields seem to have been dependent fundamentally on faulting as a control of accumulation, however. Little attention has been paid to fault trap possibilities but, because of the prevalence of faulting in Wyoming, it seems likely that fault traps will prove more common when greater attention is focused on their possibilities.

The only fields that are fundamentally of the stratigraphic type trap are those along the west flank of the Black Hills, such as the Osage and Mush Creek fields, and small fields in the southwestern corner of the state, such as Spring Valley. In the Osage and Mush Creek fields, accumulation is related to lenticularity and loss of permeability in the Newcastle (Muddy) sandstone. The original discovery was based on surface seeps,

FIG. 3. Diagrammatic cross-section through the southern part of the Big Horn Basin, Wyoming. The structure is simplified, with marginal folds on the flank of the Owl Creek Mountains eliminated.





For over 22 years Baroid Sales Division has provided oil field operators with the finest drilling mud service obtainable. Today, over 100 carefully selected and thoroughly trained field service engineers are equipped with the latest testing facilities and backed by the most modern laboratory supervision in the industry.

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followed by random drilling along the trend of outcrop. The chances for the discovery of other stratigraphically trapped pools seem rather good. There are many sandstones that are productive in certain areas that thin out and are absent in others, and lensing sands are known to be present in parts of the sedimentary section. Accumulation in the Madison seems to be related in part to permeability, although the known Madison oil has been found on structure. Exploratory thinking is turning to the possibility of stratigraph type pools, but actual drilling will probably await the time when more subsurface and surface stratigraphic information is available.

Distribution of Wyoming oil fields. Of the 23 counties in the state, 18 have commercial oil or gas production. It is possible that all counties will prove productive. The ruled areas on the map of Wyoming on page 188 are the pre-Cambrian cores of the mountain masses, and may be eliminated as possible productive territory. The crosshatched area in the northwest is occupied by volcanic rocks that had their source in Yellowstone Park. This area offers no chance for oil production. Over most of the remaining area, there are chances for the development of new fields.

Essentially all the producing fields are located around the margins of the basins. These fields represent anticlines that are observable and mappable at the surface. Many of them are so beautifully exposed as to be recognizable by most anyone with even an elementary understanding of geology —the so-called "Sheepherder anticline," since even a sheepherder could recognize its presence. Most of the fields are on anticlines that have been known for many years and many have produced oil or gas for long periods. Some have become oil fields only in the past few years simply because deep drilling has come into practice only recently. Productive depths in these marginal fields ordinarily range from several thousand feet to five or six thousand feet.

It has been in the past two years only that oil and gas fields have been found in the central parts of the basins. The Church Buttes field lies in the exact center of the Green River Basin. Four fields have been found well out toward the axial part of the Big Horn Basin; Worland, South Fork, Nieber, and Sand Creek. Production or promising shows in wells now drilling have been found well out in the Powder River and Wind River basins. The large areas in the central parts of the basins will probably yield more new fields.

New discoveries. The present oil activity in Wyoming dates back to about 1942 and between that time and the present many important discoveries have been made. These may be classed as (1) the discovery of entirely new fields and (2) the discovery of new producing horizons in old oil or gas fields. In this six-year period, 1942-1947, 41 new fields were discovered in 15 counties widely scattered over the state (Fig. 4). The importance of these fields varies; some have developed or will develop into large important producers, others will make only small fields. Nine new fields were discovered during the first seven months of 1948.

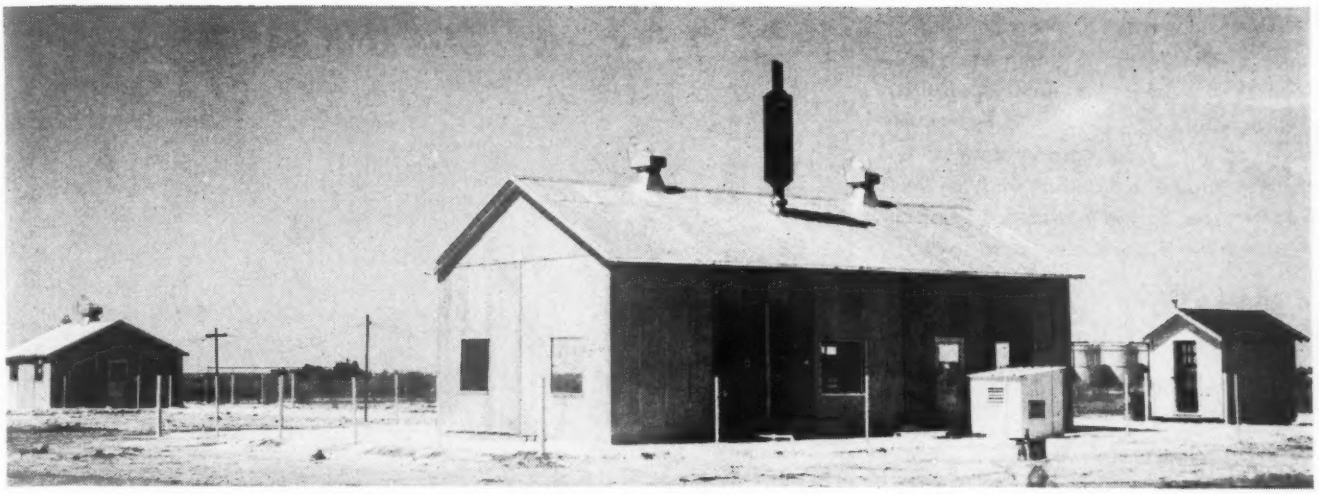
From 1942 through 1947, new producing horizons were developed in 23 old fields in 8 counties. Some old fields that formerly had not been important became heavy producers through the discovery of new pays, such as Elk Basin. Old gas fields were proved for important deep oil production, such as Big Sand Draw and Little Buffalo Basin. New deep pays found in many old oil fields added greatly to the reserves and will serve to prolong the lives of those fields. In early 1948, three new deep pays were added to the known 11 producing horizons in the Lost Soldier field. During the first 7 months of 1948, 12 new pays were found in 8 old fields.

Application of new exploratory concepts and techniques. This record of new discoveries has resulted from the application of new geological concepts and of new techniques in exploration and drilling. This situation may be illustrated by a diagrammatic cross-section through the southern part of the Big Horn Basin (Fig. 3). In the early days, only those anticlines that had surface expression could be discovered by the discovery tool then used—regional geological mapping. Gebo dome, on the left of the cross-section is such a structure. Although the dome had been known for many years and had been drilled as early as 1916 to a depth of 2700 ft, it was not until 1943 that a well was drilled to over 5000 ft to discover good quality oil in the Phosphoria.

The central part of the basin, however, is occupied by a mantle of Eocene rocks that blankets and obscures the structure of the older folded rocks. Anticlines buried by this mantle, such as the Nieber and Worland anticlines shown on the cross-section, cannot be observed at the surface but can be located through seismic exploration. Numerous other buried anticlines have been discovered by seismograph. Since great areas in Wyoming are covered by Cenozoic rocks that obscure older structures, the fact that the seismic method can be used to discriminate anticlines is indeed important in the state's future as an oil producer.

Not many years ago it was believed by many geologists that at depths of 7000 or 8000 ft the well known-oil-producing sands in Wyoming would lack porosity and hence be incapable of containing oil. This belief has been proved to be completely unfounded. Only a few years ago a 4000-ft well was considered deep. Then wells were drilled to 5000, 6000, and 7000 ft and finally, in 1931 oil was discovered below 8000 ft in the Badger Basin field, which for many years was the state's deepest producing field. The first well drilled below 10,000 ft was completed in 1939 and a second 10,000 ft well was drilled in 1940 (Fig. 4). Both were failures. In 1944 another 10,000-ft well was drilled and it, too, was a failure. In 1946, the first production below 10,000 ft was discovered in the Church Buttes field in the Green River Basin. Oil and gas were found in an anticline located by seismograph at a total depth of 12,887 ft. The second deep field to be discovered in 1946 was the Worland field, in the Big Horn Basin, with production from below 10,000 ft. In 1947, two fields, Nieber and South Fork, both in the Big Horn Basin, were discovered at depths in excess of 10,000 ft. In 1947, 10 wells were completed below 10,000 ft; 6 were oil wells and 4 were dry holes. In 1948, a discovery well was completed at West Poison Spider at a total depth of 14,307 ft. It flowed 900 bbl of 43° gravity crude. Deep drilling, therefore, appears to be an important technique in the discovery of new Wyoming oil fields.

In summary, the following observations can be made: (1) Rocks as young as Eocene and as old as Cambrian are commercial oil producers in Wyoming, (2) most fields are of the anticlinal type trap; possible fault traps and stratigraphic traps have not been fully explored, (3) buried anticlines that can be located by geophysical methods are present in the central parts of the basins and have proved to be productive, opening up large untested areas, (4) high gravity crude oils have been found in deep basinward structures in Paleozoic rocks that formerly produced only heavy sulphur-bearing crude oils in shallow structures on the basin margins, (5) rocks lying as deep as 14,300 ft are still pervious and are suitable oil and gas reservoirs, and (6) production from deep wells is apparently large enough to justify drilling costs and to yield a profit. It appears, therefore, that the future of Wyoming as an oil-producing state is indeed bright. ★ ★

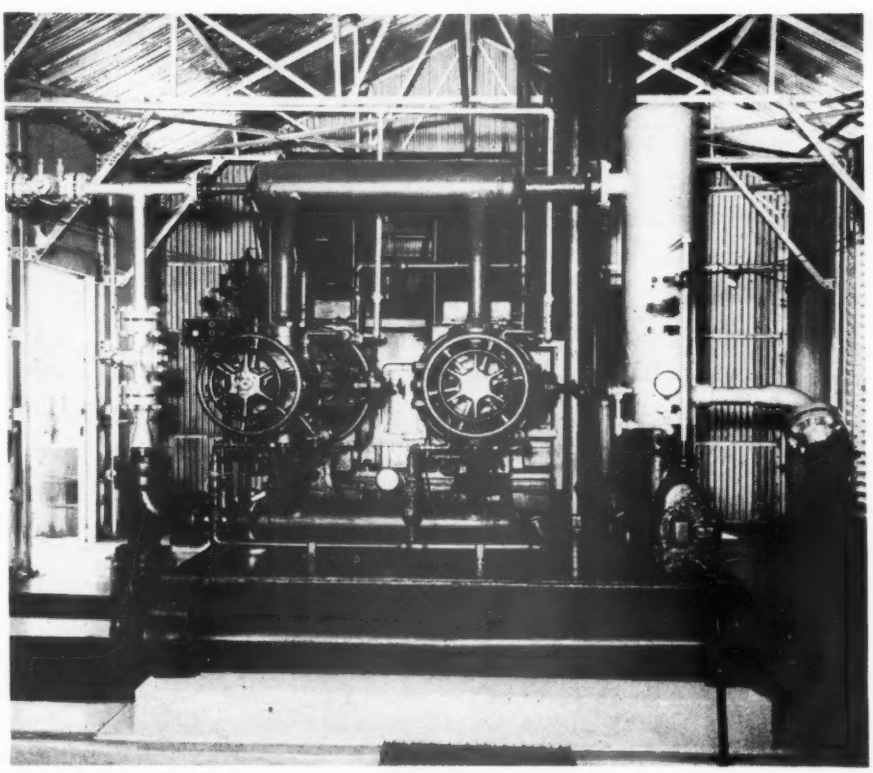


One of the two gas compressor stations constructed by Stanolind Oil and Gas Company in the Goldsmith field of Ector County, Texas. The building on the left houses the intake gas heater, and the intake and discharge meters and regulators.

Gas Injection Into San Andres Formation Begun at Goldsmith

By K. MARSHALL FAGIN*

EXCLUSIVE



The compressor unit is mounted on a skid-type steel base. Intake gas enters the scrubber (left) at a pressure of about 400 pounds psi and passes into the intake header above the compressor cylinders. Wheels on the ends of the compressor cylinders operate variable volume unloaders.

A SMALL scale gas injection project has been put into operation on six leases in the Goldsmith field of Ector County, Texas by the Stanolind Oil and Gas Company and Landreth Producing Company with Stanolind as the operator. Although the present operation is relatively small it may prove the economic feasibility of returning gas into the rest of the San Andres dolomite reservoir in this and other similar Permian lime fields in the West Texas and New Mexico area:

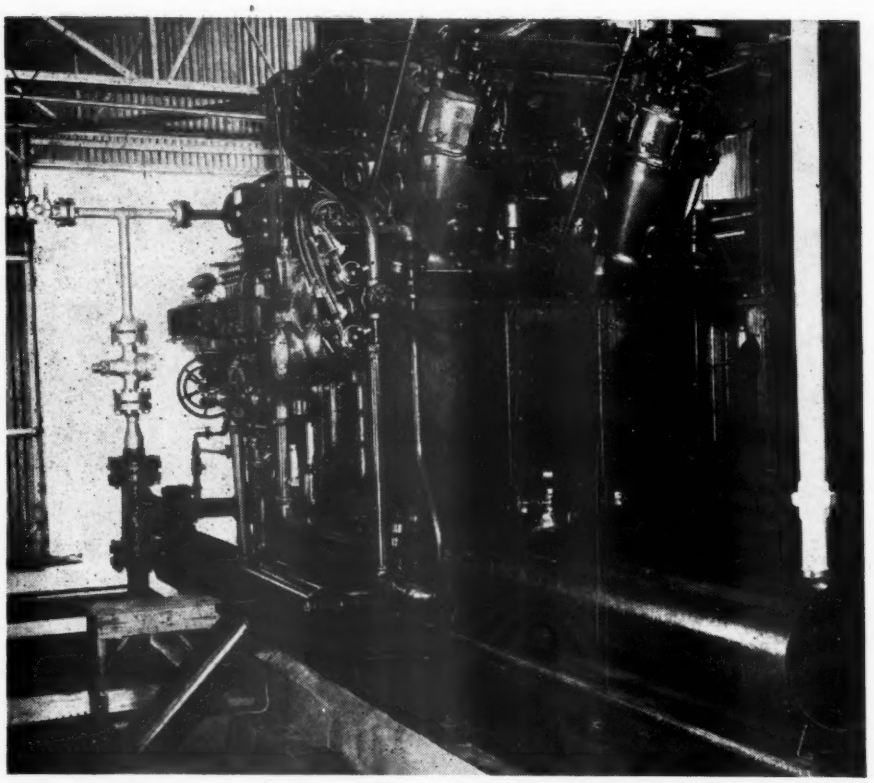
The San Andres reservoir in the Goldsmith field is about 4200 ft deep with a domal anticlinal structure. Oil and gas are produced from several zones of varying permeability in the San Andres dolomitic lime section. The average productive thickness is about 75 ft, the average porosity is about 10 per cent, the average permeability about 25 millidarcys and the connate water saturation about 15 per cent.

The reservoir oil was originally saturated with gas at an initial reservoir pressure of 1727 psia. The 21,000-acre field has two large gas caps, on in the north part and one in the south part of the field.

The reservoir energy that produces the oil is apparently due to expansion of the gas in the gas caps and to the gas in solution in the oil. No effective water drive appears to be present.

Although the discovery well was completed in December, 1934, the field was

*Editor, Exploration, Drilling and Production Section.



Side view of the 4-cylinder, 200-hp gas engine driven compressor in Stanolind's Scharbauer "F" compressor station. Air for the engine enters the base through the 4-in. pipe laid in the trench covered with steel floor grating. Gas for the engine is piped down from the roof trusses to the horizontal volume tank mounted on engine base (right).

not developed actively until 1936. About 1030 wells are now producing about 25,000 bbl daily of 36-deg API gravity oil from the San Andres reservoir, or about 24 bbl daily per well. The field had produced about 85,900,000 bbl to July 1, 1948, or an average of about 83,000 bbl per well. This is a recovery of approximately 4000 bbl per acre.

The average reservoir pressure had declined to 1123 psi in June, 1947, as compared to the initial pressure of 1727 psi, or a drop of 604 psi while producing about 76,900,000 bbl.

The average gas-oil ratio had increased

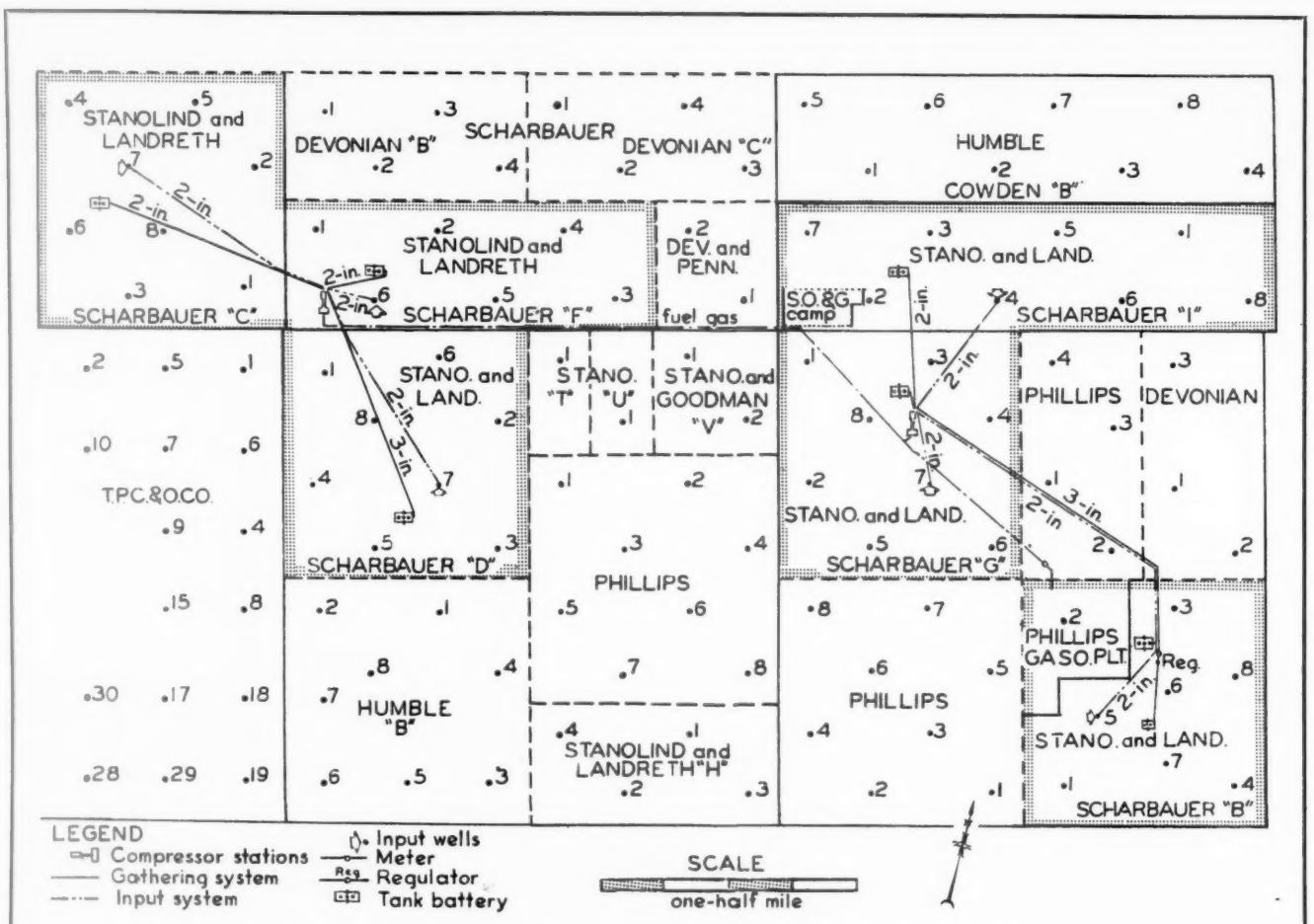
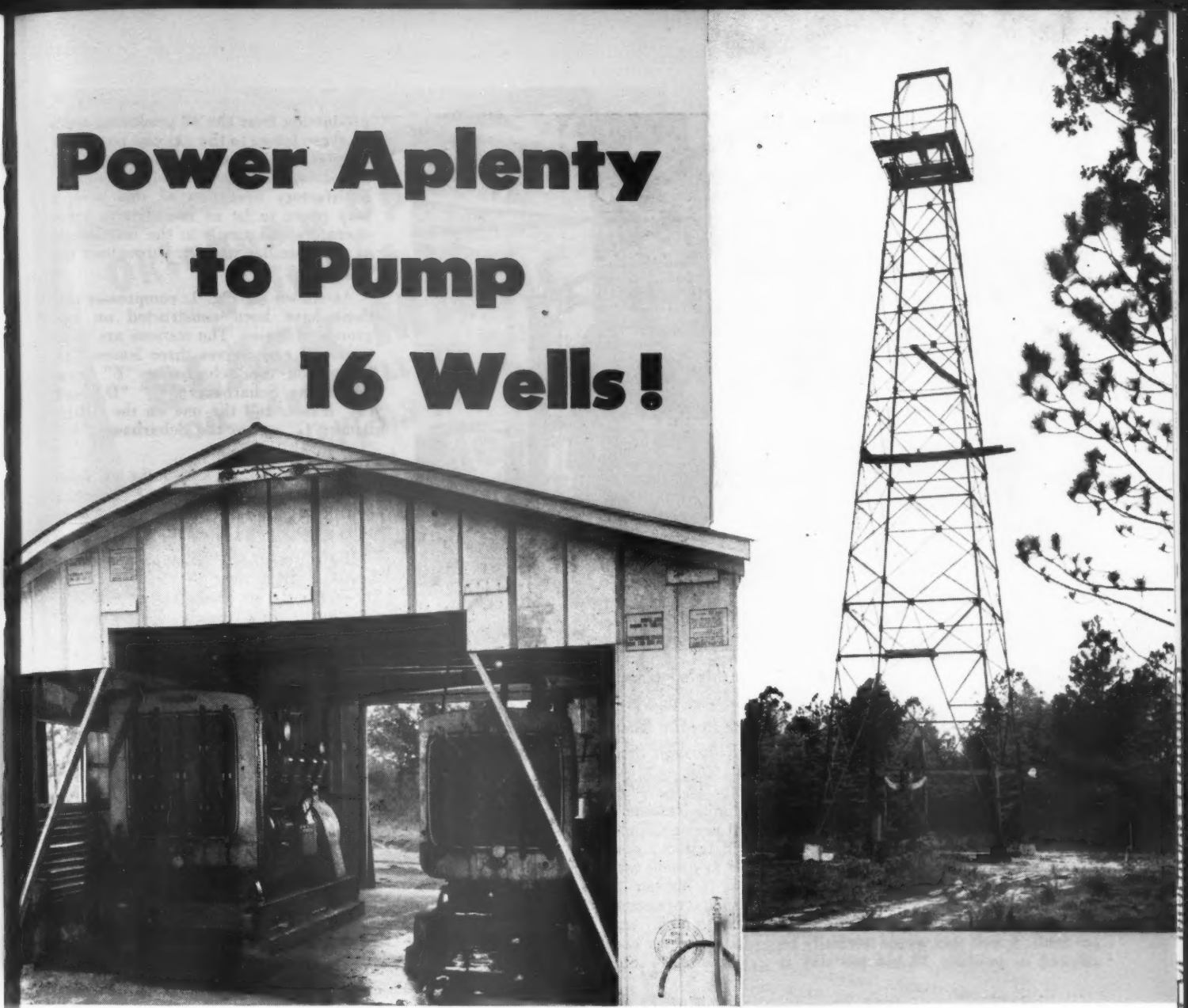


Fig. 1. The six leases involved in present gas injection project of Stanolind Oil and Gas Company and Landreth in Goldsmith field, Ector County, Texas, are shown on above map. Note gas is gathered from the same leases into which it is injected.

Power Aplenty to Pump 16 Wells!



YES, there's power aplenty—24 hours a day, 30 days a month, 12 months a year—from the two "Caterpillar" Diesel Electric Sets that supply the current for all the pumping at the Kirby Petroleum Company's Langsdale Field, near Quitman, Miss. A D17000 and a D13000, each with more than 3500 hours on its hour meter, team together to keep 16 wells in profitable production, running the following sizes of electric motors: four 7½-hp., ten 10-hp., one 15-hp. and one 20-hp.

Regarding these partners in reliable, low-cost power, Supt. J. B. Todd reports: "These electric sets have been satisfactory. Service from our dealers has been good." And many other practical men who value action above words agree with him, because "Caterpillar" Diesel Engines have proved their worth in action again and again in scores of fields.

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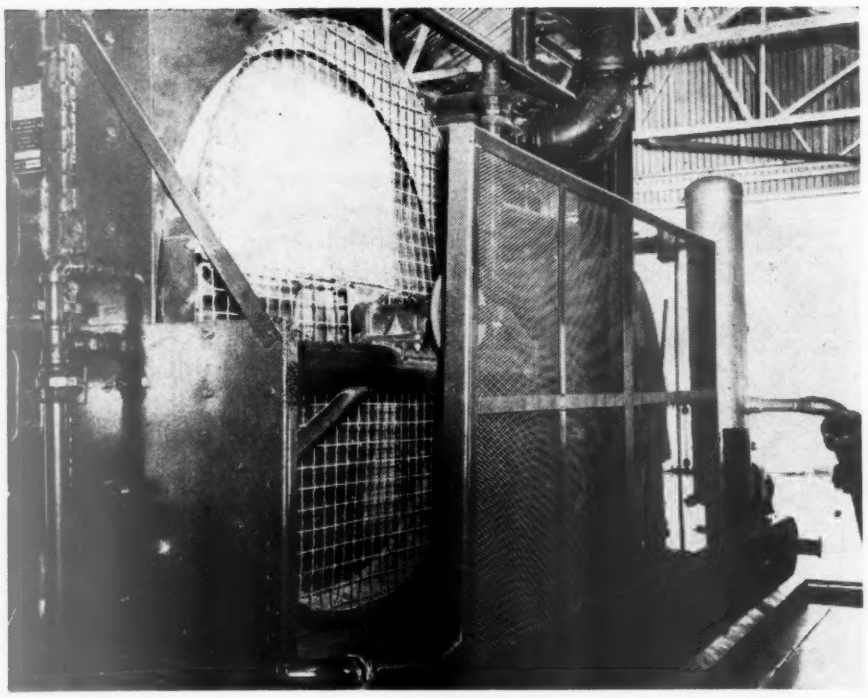


The engine-compressor unit is cooled by this large radiator and fan, which is mounted on the skid-type steel base. Air enters the building through a slat-type ventilator in the wall opposite the fan (see photo). The exhaust pipe from the engine is turned upward through the roof. (upper right).

from the initial solution ratio of 757 cu ft per bbl to 3140 cu ft per bbl in September, 1947, and it has continued to increase since then, although wells that produced more than 2000 cu ft per bbl were limited to the production of whatever oil they could produce within their gas limit. A well that would normally be allowed to produce 40 bbl per day is limited to the production of 80,000 cu ft per day. The well would thus be limited to the production of 20 bbl per day if its gas-oil ratio was 4000 cu ft per bbl, or 10 bbl per day if its gas-oil ratio was 8000 cu ft per bbl.

Stanolind and Landreth's gas injection project on six leases in the field is designed to return most of the excess gas production from the 40 producing wells on these leases to the gas cap portion of the reservoir, thereby saving the gas and increasing the allowable oil production. Satisfactory operation of this project may prove to be an incentive to other operators and result in the installation of other similar projects throughout the field.

As shown on Fig. 1, compressor stations have been constructed on two groups of leases. The stations are identical and each serves three leases. The station on the Scharbauer "F" lease serves the Scharbauer "C," "D," and "F" leases, and the one on the Scharbauer "G" serves the Scharbauer "B," "G," and "I" leases.

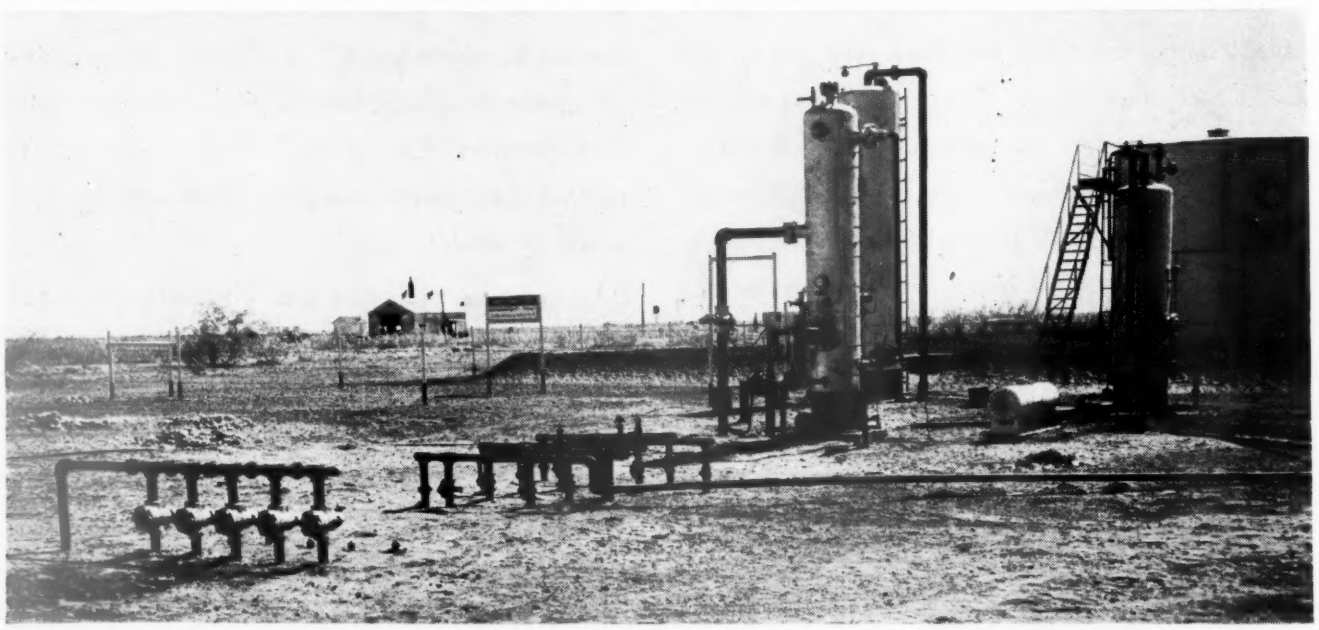
The gas produced with the oil from the wells in this field is sour, having a hydrogen sulphide content of 1400 to 1800 grains per 100 cu ft.

High pressure gas-oil separators have been installed near the tank batteries on each of the six leases, and special flow line headers have been constructed, so that any of the producing wells may be flowed through the high pressure separators, where gas is now being obtained at a pressure of about 400 psi.

The gas from the high pressure separators flows through 2-in. or 3-in. lines (sizes are shown on Fig. 1) to the meter and regulator houses built near the compressor stations. The gas then passes through a heater, through separate orifice meters, and regulators before being compressed to a pressure of about 950 psi for injection into the key wells on each lease. The key wells are now taking about 300,000 cu ft a day at a pressure of 950 psi.

The key wells were plugged back from their former total depths as pro-

The flow of oil and gas from any or all of the five wells on the Scharbauer "F" lease can be diverted from the low pressure separator (rear) and directed through the header at the left to the high pressure separator (in front of the low pressure trap). A low pressure test separator is seen at the right. The compressor plant is visible in the distance.



Oklahoma Operator switches to BLACK MAGIC OIL BASE DRILLING FLUID and converts a "dry" hole into 720 B/D flowing

Here's an actual report from the field:

"This well is located in Garvin County, Oklahoma. The well was originally drilled with water base mud. The top of the pay sand was found at 6591'. The well was drilled to 6667' TD. Net sand fom 6591' to 6667' was 15'.

"Tubing was run with a packer at 6566' and the well swabbed 9 bbls. oil in 14 hours. It was acidized with 1000 gals. after which it swabbed 37 bbls. oil in 11 1/2 hours. They then reacidized with 3000 gals., displaced the mud with crude and actually swabbed the tubing dry, getting no production.

"At this point they went back up the hole, perforated the sand behind the pipe that was drilled with water base mud, with 226 shots. Again the well was swabbed dry, this time with no show of oil.

"A plug was set in at 6540'. They came up the hole and set a whipstock at 5413'. A controlled directional hole was then drilled using an oil emulsion mud. The top of the sand was encountered at 6582'. It was calculated at this point that the sidetracked hole was 82' laterally from the old hole. After cementing, the oil emulsion mud was displaced with BLACK MAGIC. The new hole was drilled to 6634' TD, and showed 16' approx. of net sand. According to geologist they had, within one foot, the same sand section in the sidetracked hole as in the original. Black Magic was displaced with crude oil. The well started flowing immediately and made 300 bbls. of 40.1 gravity oil the first 10 hours on a 3/4" choke. This is at the rate of 720 B/D. The next 24 hours on a 16/64" choke it made 251 bbls. The well is now choked to the field allowable and is considered a very good well for this part of the field."

This is one more example

of how water loss to the oil formations, from use of water base muds, can seriously block all recovery **sometimes reducing permeability of sand as much as 60 times.*** Black Magic has a filtrate loss of zero. It cannot and will not "waterblock" or "mud off" the pay section. Black Magic deposits a paper thin mud cake that readily disintegrates when crude oil displaces it, allowing the well to come on production, usually without swabbing, and assuring the highest return possible.

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*API Paper: 801-20E, March, 1944.

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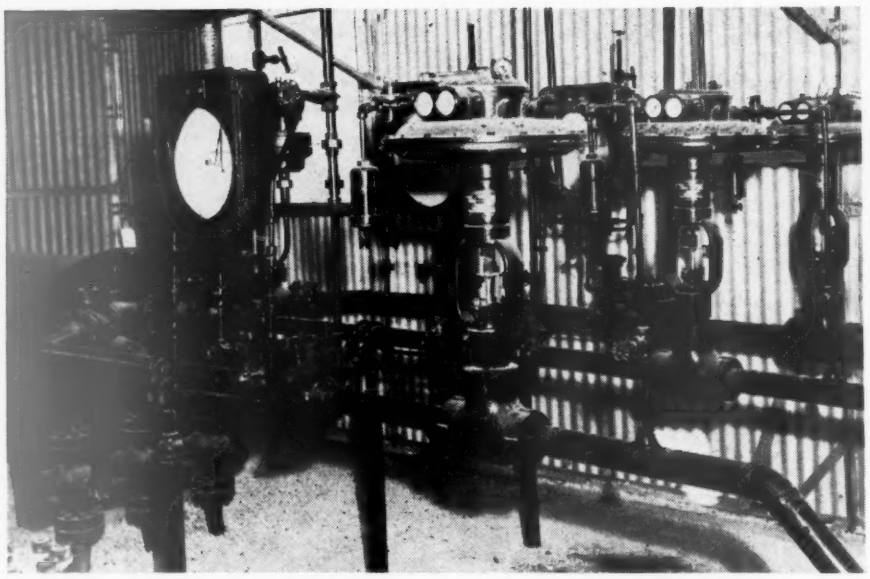
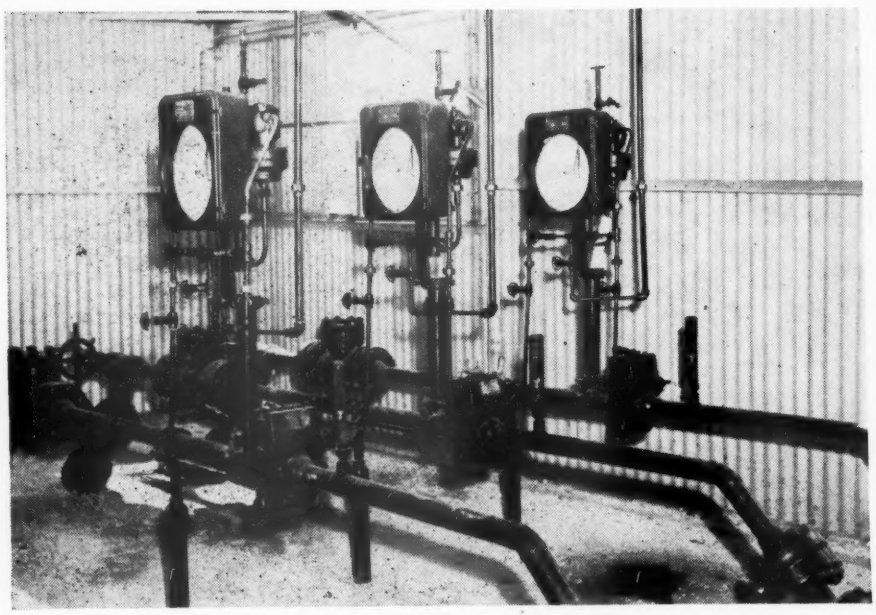


Gas from the high pressure separators at the three lease batteries shown above passes through the heater (at left), through the three orifice meter runs, and through the intake pressure regulators in the meter house behind the compressor station. Intake pressure varies between 400 and 500 psi.



After the gas has been compressed to about 950 psi the photo at right shows where it passes through the choke beans (left) on the lines to the three key wells, through check valves, and through the meter runs. About 300,000 cu ft per day is now being injected into each of the three injection wells.

ducers in the oil zone, so that the gas would be injected into the gas cap zone of the producing formation. A temperature survey was first run to determine the gas-oil contact. A radioactivity survey and spinner permeability survey were then made to locate the porous zones in the gas cap section. The wells were then plugged back with gravel and a plastic cap to a point slightly above the gas-oil contact.

A permeability profile survey was run to establish the location of the permeable zones and to determine whether the plugback was effective by showing whether fluid was lost by the casing seat or by the plug.

After the plugging back work was checked, a production retainer packer was run on the tubing and set in the last joint of the oil string above the plug, so that the production string of casing would not be subjected to high injection pressures.

Prior to converting the producing wells into injection wells, the productivity of the wells was determined, so that the allowables of the converted wells could be transferred to other wells on the leases. The oil allowables of the other wells on a lease are also increased by the amount of credit gained through the injection of gas into the key well.

On a lease with seven producing wells, for example, the wells might have an average potential of 1000 bbl per day and a normal allowable of 37 bbl (as calculated by the 50 per cent acreage plus 50 per cent potential formula). Their gas limit, then, would be 2000 times 37, or 74,000 cu ft per day per well. With an average gas-oil ratio of 3100 cu ft per bbl, however, the average actual allowable would be 74 divided by 3.1, or 24 bbl per well per day.

With the injection well on the above lease taking 300,000 cu ft per day, the allowable of these wells would be increased from 24 bbl per day to the normal 37 bbl per day due to the credit for gas injection. Thus, an additional 91 bbl per day would be allowed the lease. In actual practice, insufficient gas is being injected to remove all penalty; however, the difference is small. The net gas produced is piped to the gasoline plant for processing.

The credit for gas injected into a lease is allocated first to the wells with the lowest gas-oil ratio. In this way, the wells with relatively low gas-oil ratios are the ones that would be allowed to produce their full normal allowables, and high gas-oil ratio wells would remain pinched back, unless enough gas was being injected to increase their allowable.

As many of the wells in the Goldsmith field produce more than 2000 cu ft of gas per bbl due to downward channeling from the gas cap, Stanolind and other operators in the field have been working over the high gas-oil ratio wells in an attempt to shut off any of the gas cap zone that was exposed by the expansion of the cap. Special attention has been paid to the problem of working over the wells in the gas injection area, so as to reduce the gas-oil ratios.

Three main types of workovers have been tried: (1) Steel liner installations; (2) packer installations, and (3) plastic squeeze jobs. Liner installations were not considered to be very effective due to the difficulty in performing future additional workover operations. Packer installations likewise have been difficult to workover again when necessary, due to the trouble and expense involved in pulling them after they have been set for awhile. Most of the trouble seems to be due to corrosion.

Plastic squeeze jobs have been giving encouraging results; however, the permanency of this type of workover has not yet been determined. * * *

FROM ROAD TO RATHOLE IN A MATTER OF MINUTES

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The above sequence of photographs show an actual moving and rigging job in South Texas.

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SUMMARY OF DRILLING COSTS

(Wells Drilled in United States)

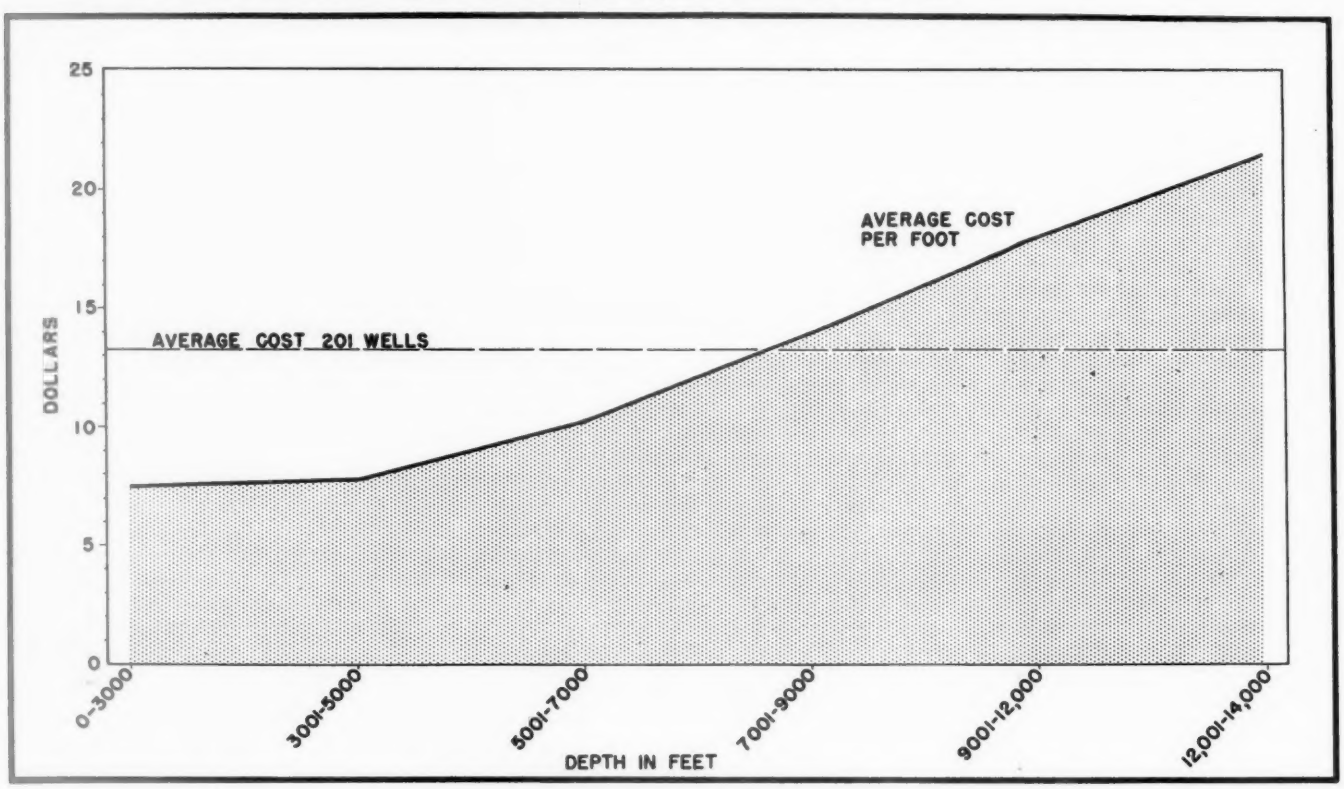
No. wells	Type of wells	Average depth	Days drilling time	Intangible cost	Equipment cost	Total cost	Cost per foot		Total cost per day
							Equipment	Total	
71	Dev. producers	5,303	2,678	$3,120,553	$1,255,321	$4,375,847	$ 3.33	$11.62	$1,634
16	Dev. dry holes	5,216	562	613,810	119,024	732,834	1.43	8.78	1,304
9	W. C. producers	5,899	324	399,897	232,428	632,325	4.38	11.91	1,952
23	W. C. dry holes	5,168	1,096	863,673	93,423	957,096	0.79	8.05	895
119	Total	5,2`6	4,660	$4,997,933	$1,700,196	$6,698,1[illegible]9	$ 2.73	$10.77	$1,437
87	Other*	7,070	—	—	—	9,699,287	—	15.77	—
206	All wells	6,055	—	—	—	$16,397,416	—	$13.26	—

*Incomplete data.

BREAKDOWN OF ALL DRILLING COSTS BY DEPTH RANGES

Depth	No. wells	Total footage	Average feet per well	Total cost	Average cost per well	Average cost per foot
0– 3,000	29	68,291	2,355	$ 500,269	$ 17,252	$ 7.33
3,001– 5,000	59	229,094	3,883	1,775,367	30,091	7.75
5,001– 7,000	35	205,646	5,876	2,104,582	60,131	10.24
7,001– 9,000	49	387,134	7,901	5,380,494	109,806	13.90
9,001–12,000	29	293,898	10,134	5,284,431	182,222	17.98
12,001–14,000	5	62,944	12,589	1,352,246	270,449	21.48
Total	206	1,247,007	6,055	$16,397,416	$79,599	$13.15

Source: Cost records of major and independent operating companies and drilling contractors.



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20
0
20
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60
80

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Export Men Have Unique Organization

By RICHARD SNEDDON, *Pacific Coast Editor*

For several years a rather unobtrutive little band of oil equipment export representatives have met at a weekly luncheon in Los Angeles, to exchange news and views on foreign operations, and to stimulate as far as possible what the French people used to call the "entente cordiale," or what in this country is called the "good neighbor" policy. This organization has no name, and its activities are rarely if ever recounted in the trade press. As a matter of fact, there is a very evident tendency to soft pedal or quash completely any news relating to organizational affairs. And yet, close observation indicates that beyond the exchange of information about foreign operations and people, the members of the gathering are active in many interesting ways, particularly as hosts and advisors to visiting oil men from other parts of the world.

During the past year the meeting place of the group has been in room 405 at the Jonathan Club. An oil man going to or coming from a foreign assignment and finding himself in Los Angeles on Tuesday of any week, would do well to stop in and introduce himself—he will find a ready welcome. Most of the regulars who sit in on these sessions are widely traveled individuals. They discourse easily and interestingly on conditions in the Latin-Americas, the Middle East, Europe, and, indeed, wherever oil is to be found. But, their most remarkable stock-in-trade is an amazing familiarity with the people in charge of drilling and production. They seem to know minutely as of yesterday, not only what is going on in the Philippines, Morocco, and everywhere else, but who is in charge of the various phases of every foreign oil project that is under way.

How this is contrived we haven't yet found out—we suspect it is done with drums or some other sort of voodoo, but anyway, they seem with unfailing accuracy to keep themselves advised of all projected visits by men engaged in foreign operations, no matter from what part of the world they come. They know who is coming to the United States from the outside. They know who is going into foreign fields. And they know exactly when these migrations will take place. They make it their business if at all possible to contact such people and to offer their services as guides. It is seldom, in consequence, that a Tuesday meeting takes place without one or more foreign visitors in attendance. There is nothing high pressure about all this either. Having sat in on many of the deliberations, we have noted a keen anxiety to avoid ways that smack of imposition, and to make sure that the guest is really and sincerely desirous of the attention he gets.

The meetings have now been carried on so long and the members of the group have traveled so extensively that the guest is seldom a complete stranger. Regardless of whence he comes, he is almost certain to have been visited by one or other of the export boys, and attendance at the luncheon is thus largely in the nature of a reunion. Jerry Engstrand, Grant Oil Tools, is the nominal chairman of the group and has been for some time. Jerry is well known to oil men in Europe and the countries south of the border. As emissary of the Olympic Committee he visited every Latin-American capital prior to the games in London and extended a formal invitation to participate. Bill Riggins, Hydril Corporation, as this is being written is in South America. Bill, when at his home office is one of the regulars. He also has scoured the seven seas and is well and favorably known to oil men all over the world. Then there is Vernon "Mitch" Mitchell, Security Engineering Company, Inc., who seems to have friends scattered all the way from Yonkers to Yokohama. The first thing almost every foreign guest does when he shows up in Los Angeles is to look up Mitch, and together they go into a spasm of remembering joint escapades that makes the Thousand and One Nights sound just a bit childish.

Another recent world traveler who is usually to be found at these meetings is Knight Templeton of Champion and Smith, Inc. Knight made a tour of the Latin Americas not long ago, and extensively widened an acquaintance that was by no means narrow to

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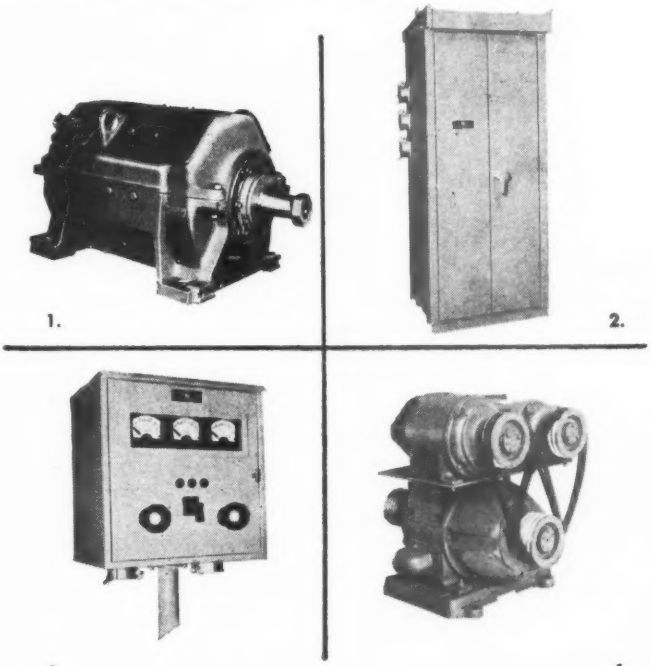

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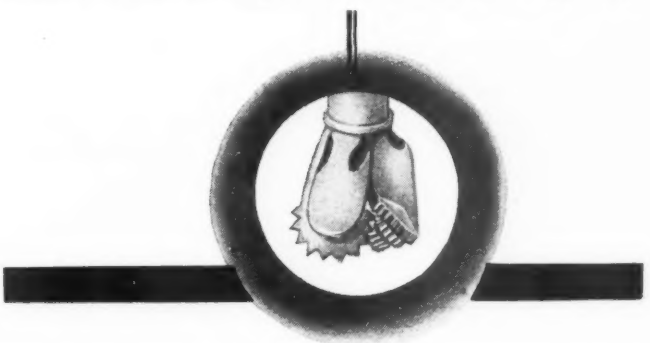

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GENERAL ELECTRIC

begin with. Johnny Flanagan, The M. O. Johnston rep, who used to alternate with Bill Bettis, has gone to Tulsa to become a pipeliner, and his place has been taken by Norm Andrew. Although new to the export game, Norm has skimmed all over the European theater as a navigator in the army airforce during the late lamented world war. Tom Martin, up and coming club man, Bob Eiche's right arm, is another cosmopolitan who rarely misses a session, and usually arrives in company with at least one foreign guest. Then there is Frank Gilstrap of four company fame—on the slightest provocation he will name them. Frank is one of the West's best informed men on foreign operations and operators, and nobody keeps closer tab on the movements of foreign guests. A long time member is Larry Coker, now handling materials and supplies for Gulf Oil Company at Kuwait.

A comparatively new recruit to this exclusive assembly is Bob Kirk, the Byron-Jackson Company rep, who roamed the Pacific with the army aviation engineers during the war, and had a big hand in building that first B-29 landing field at Saipan. Looking in briefly on his way to Texas and thence to New York, where he will be assisting Ben Hilliard, is Bill Cook, erstwhile navy pilot who did three tours in the Aleutians — one of the roughest flying assignments in the entire war schedule. Bill saw the Aleutian campaign through from the first assault on Attu to the bitter end. Another lad who mushed around that northwest area is Bob Shira, Patterson-Ballagh's new export aide, who spent a lot of war time in Northern Canada and Alaska as weather officer in the army. If you have ever flown in the dead of an Alaskan winter you can appreciate the importance of his work there. Bob will be associated with Earl Rees, an occasional attender at these luncheons, a highly regarded individual in export circles, and at present in South America. Among occasional popper-inners, incidentally, are Bob Eiche, Henry Pullman, Earl Boggess, "Van" Van Loozen, and almost everyone else in the Los Angeles area who is interested in the exportation of oil equipment.

This unique group, although it has no formal name, has no membership cards or dues, and meets without ballyhoo or ostentation, is doing an excellent job of foreign relations. Its membership, being comprised of men who have traveled wide and far, constitutes a source of invaluable information to the oil and allied industries. It is a steering organization that can guide the neophyte away from all sorts of difficulties and dangers when he makes his first trip into foreign territory, and can help him to so conduct himself as to make the best impression for his firm, his industry, and even his country. The members who have jointly and severally visited every oil field in the world, some of them many times, know what is demanded of the visitor, and they appear to be not only willing but anxious to make sure that every oil man who goes into a foreign field will comport himself in an agreeable manner.

Having been, in the main, submitted to a gracious acceptance and kindly treatment by the peoples of the lands in which they have visited, the members of this group are fully determined that they shall reciprocate in kind. They exercise every effort to contact the foreign visitor immediately on his arrival, and they strive to make his stay in the United States just what he himself most hopes it will be. All this has been productive of very fine international relations, and we often wonder if this small group of export men, who meet every week in Los Angeles, are themselves conscious of the deeper significance of the work they are doing.

* * *

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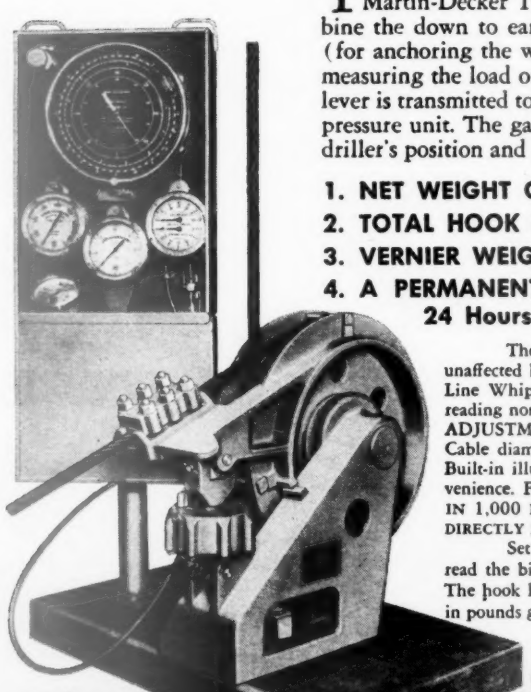

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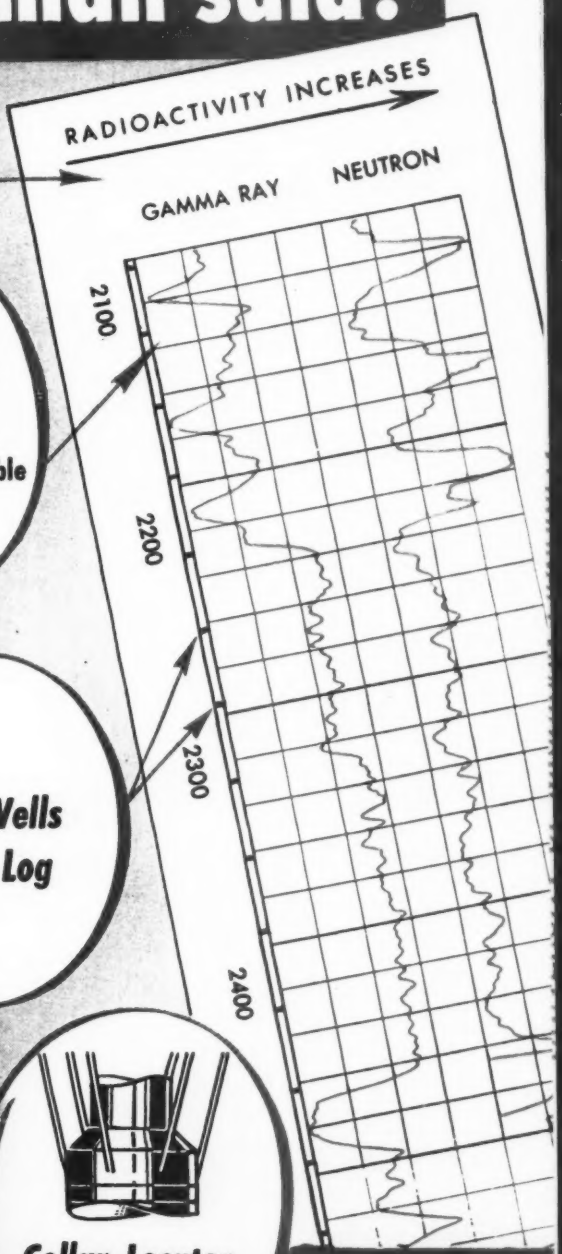

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* *Condensed from a magazine article by a petroleum engineer with one of the major oil companies.*

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Late Exploratory Developments in Wyoming

By IRVING GARBUTT

EXCLUSIVE

DRILLING activity reached a new peak in Wyoming as the last quarter of the year was turned. Nearly 200 wells—a third of them wildcat ventures—were boring ahead at the end of October, while 60 new locations were on the board for late starts this year.

One of the mildest Octobers on record favored late drilling activities, but operators in the more inaccessible places like Jackson Hole and the slopes of the Rockies were either winterizing their rigs or preparing to shut down for the winter months.

As the biggest boom year in Wyoming's oil history drew near a close, the fact that one successful wildcat does not make a "field" was more and more impressed on the oil fraternity.

Continental Oil Company, which made one of the year's headline strikes at Taylor-Sussex, only 18 miles north of Salt Creek, met with disappointment in the second test, a quarter-mile offset to the east. While the discovery continued to flow 250 bbl per day through choke from the Lakota formation, the second test found the formation hard and tight. It was drilled to the Sundance at 8073 ft before being chalked up as a duster. Now Continental is drilling a west offset to the discovery.

The damper was applied also at Long's Creek, in Fremont county, when British-American abandoned a formerly promising wildcat in an area near the productive Sand Draw oil and gas field. The test found good shows of oil and gas in the Embar, as well as saturation in the Tensleep but subsequent drill stem tests were plagued with water. The company plans a new test in the spring.

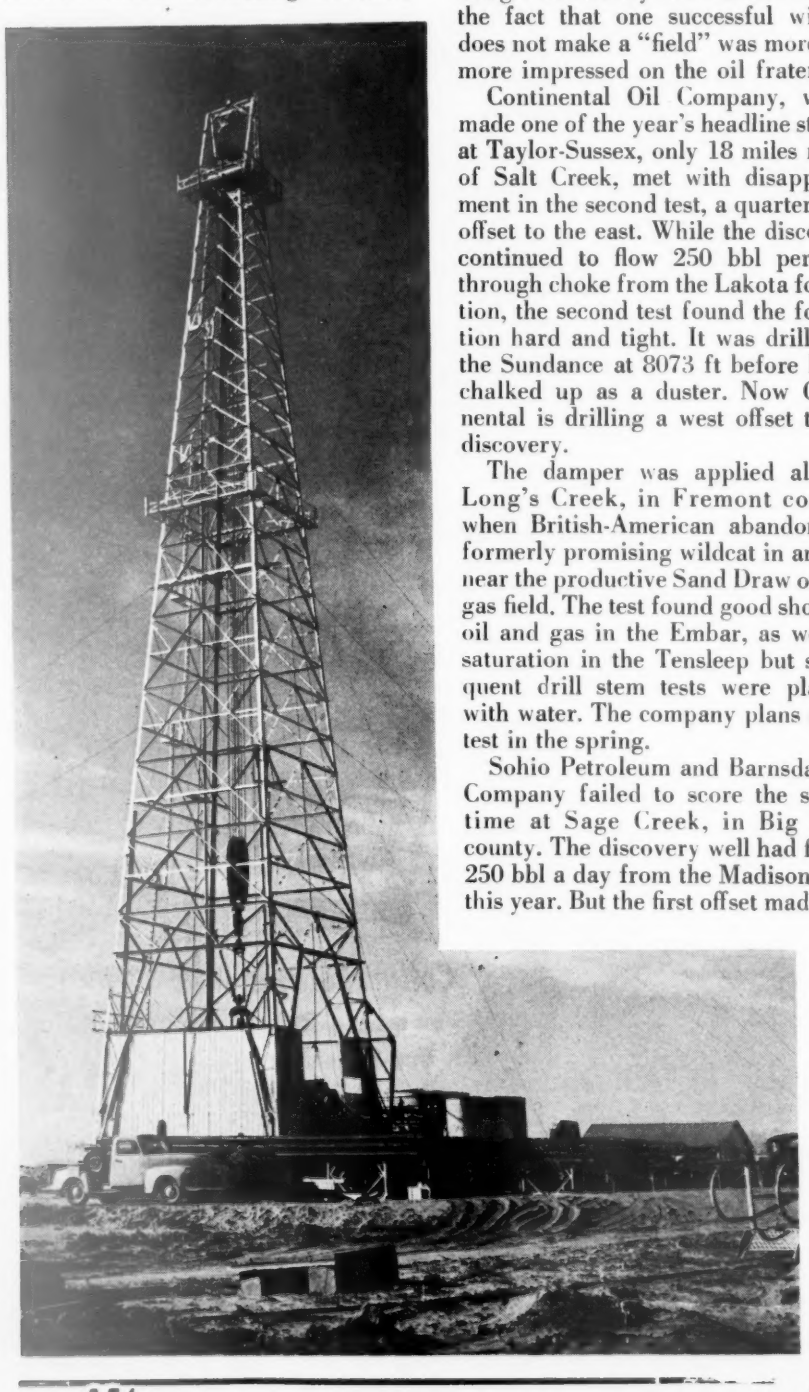
Sohio Petroleum and Barnsdall Oil Company failed to score the second time at Sage Creek, in Big Horn county. The discovery well had flowed 250 bbl a day from the Madison early this year. But the first offset made only one barrel an hour following heavy acid treatment.

Among most recent new strikes was that made by Pacific Western at Pilot Butte, Fremont county. No. 1 Stock came in on the south side of the field for 800 ft of clean, 27 gravity black oil from the Tensleep, at 6095 ft. The well extends the limits of the field more than a mile to the south.

Phillips Petroleum Company's South Cole Creek discovery in western Converse county was completed recently for 160 bbl per day from the Lakota, sparking new interest in the west side of the Powder River basin. The operator is now drilling on the first offset well.

Sharples Oil Company has just completed its first well in the booming River Dome field north of Worland, where Pure Oil Company developed the biggest postwar field in the state from the Embar zone, reached at depths around 10,000 ft. The first Sharples well, on Holly Sugar Company land, flowed 480 bbl of 44.5 gravity oil per day through 28/64-in. choke, following heavy acid treatment. It is rated as a 700-bbl producer. Sharples is going ahead with a second well.

The spotlight turned again to the general area west and northwest of Mush Creek in the eastern Powder River basin as Clark Drilling Company struck pay at Fiddler Creek (19-46N-64W). The well flowed 53 bbl of 48 gravity crude through casing in 10 min, then settled down to 26 bbl an hr through ¾-in. choke. Production came from the Newcastle sand between 4502-4552 ft.



World's largest rig, this National 160, which held the spotlight at the International Petroleum Exposition in Tulsa last summer, is doing a king size job drilling a deep test for Superior Oil Company at Pacific Creek, near Farson, Superior County, Wyoming. Over 200 ft high, this lofty rig is equipped with a communication system so the crew members won't have to shout themselves hoarse. Now drilling below 10,700 ft, this wildcat is expected to go anywhere from 15,000 to 18,000 ft deep, possibly setting a new depth record for the Rocky Mountain region in 1949.

—Photo by Dean Conger, Casper.

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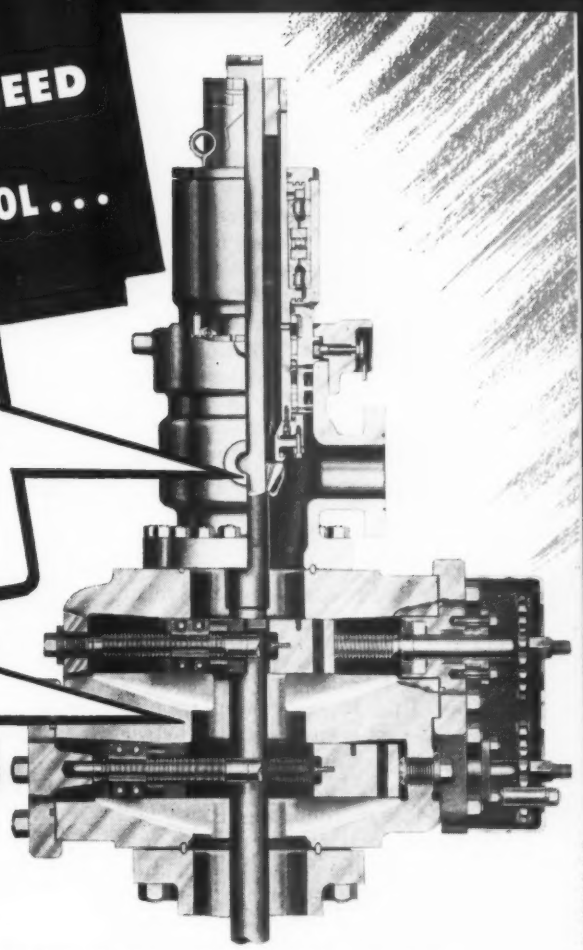

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The above is only a brief outline of the *complete* pressure protection this Shaffer Hook-Up provides. The Shaffer Combination Rotating Blow-Out Preventer and Stripper is *fully automatic* in operation, maintaining its pressure-tight seal *continuously* around the various shapes and diameters in the drill string with no manual adjustments or attention of any kind. Pressure emergencies just can't happen too fast for this unit because it is *always* sealed off around the drill string as long as pipe is in the hole, *instantly* ready for pressure protection!

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Drilling has continued at a rapid rate this year in the Mush Creek-Skull Creek fields, with operators coming up with good producers consistently. Among the more active operators in this monoclinal field are Brinkerhoff, Clark Drilling Company of Morton, Texas, Trigood, Phillips, and Mush Creek Production. Daily production is running about 4500 bbl, with 80 wells pumping or flowing. The oil, 42 gravity, sells for $2.85 a barrel in the field, and some of it is moved by rail as far as Moosejaw, Canada, where it is laid down for $5.

The fury of Wyoming winter and snow-drifted roads is expected to slow up drilling activities to some extent, but already there are indications of an even bigger year ahead in '49.

One of the biggest land plays of the year has just been negotiated between Union Oil Company of California and the Continental Oil Company. Union acquired an undivided half interest in the Continental checkerboard lease play through the entire Powder River Basin—an area covering more than 400,000 acres of federal, state, and fee lands. The two companies may conduct joint seismic and geological operations over the vast area next year.

Several significant wildcats are expected to shed new light on the potential reserves along the west side of the Powder River basin. Amerada's interesting Sage Spring Creek test in Natrona county—halfway between Teapot Dome and Cole Creek fields—has drilled through the second Wall Creek sand on the way to the Sundance, at 8,000 ft. Non-commercial shows were found in the second Wall Creek, productive in Salt Creek.

Shell is drilling below 8000 ft in its wildcat test at Clear Creek, in Sheridan county, which fills in the boundary of the Powder River basin north to the Montana line.

Amerada has just staked out a deep test at Smith's Cut, about 10 miles north of Continental's Sussex unit. The test is expected to reach 10,000 ft. Tide Water Associated is drilling a wildcat at Tisdale, west of the Sussex unit in Johnson county.

In the Green River basin of southwestern Wyoming, where geologists say the sedimentary beds run as deep as 40,000 ft, two major wildcat tests hold the spotlight. Superior Oil Company is drilling below 11,250 ft at Pacific Creek (Sublette county) in what may prove to be the deepest well in the Rocky mountain region sometime in 1949. The company is employing the biggest rig in the region, a National 160, for a test that may run 15,000 ft. General Petroleum is drilling below 8750 ft at Tip Top, also in Sublette county.

Mountain Fuel Supply has completed its fifth well in the 12,000-13,000-ft deep Church Buttes field in southwestern Wyoming, which is proving to be one of the largest natural gas reserves of the region. Well No. 5, drilled to 12,770 ft, extends the productive limits of the field more than a mile to the east of the discovery well.

In the Big Horn basin of northwestern Wyoming, Stanolind has the deepest current test at Big Sand Coulee, in Park county, now drilling below 12,100 ft and seeking the Tensleep at 13,000. This test is south of Seaboard's new Silver Tip field and southwest of Wyoming's biggest field at Elk basin.

Continental is drilling the first Madison test at North Danker in Park county. Seaboard and Husky are below 3500 ft in the first Tensleep test of Little Sand Draw, Hot Springs county.

In the picturesque Jackson Hole region, Stanolind is drilling below 4068 ft at Spread Creek (Teton county). Carter Oil Company is coring below 689 ft in the Tensleep formation in the Red Hills area in Jackson Hole, finding the formation hard and quartzitic with streaks of oil in fractures.

So far, and surprisingly enough, there has been no howl from nature lovers over spoiling the scenic grandeur of Jackson Hole, but no great optimism, either, that a great new oil pool will be discovered. Steep, vertical dips on the flanks of sharply uplifted mountains are anticipated.

Further south in Lincoln county, near the Wyoming-Idaho line, Shell is drilling below 2500 ft in the first Tensleep test of that area. Continental has also spudded at Afton, in Lincoln county, for another deep test starting at an elevation of 8200 ft. The reports from this area are expected to show "snowed in" for several months.

In the mountainous Wind River region of west-central Wyoming, British-American has closed down for the winter at Whiskey Peak, Fremont county. Drilling will be resumed in the late spring for a test of the Cretaceous sands at around 10,000 ft.

Near Riverton, in Fremont county, Atlantic Oil Company is coring at 9270 ft in a well that previously struck a large flow of gas in the Frontier formation.

And in the plains of eastern Wyoming, Tide Water is gambling on a 10,000-ft test at Bright Unit, Niobrara county. The well, now drilling below 6000 ft, may be completed before year's end.

In central Wyoming, Pure is now drilling below 7500 ft in its first offset to its world's record producer (14,309 ft), and may schedule other wells in this extremely deep field in 1949.

Pure's discovery has stimulated exploration throughout central Wyoming. It was reported here this week that Superior is planning a deep wildcat test of the Wallace Creek structure 20 miles northwest of West Poison Spider. Atlantic, Stanolind, Pure, and others have seismic blocks through this area.

Just 20 miles west of the Wallace Creek block, Southern Production Company of Shreveport, Louisiana, and others are drilling a wildcat at Glasner Dome, in Fremont county. Southern Production recently paid $1,050,000 for the Barber leases held by Dyer and Rice, drilling contractors, in the Big Muddy field east of Casper. This old pumping field has been extended considerably to the east during the past year.

* * *

Wyoming Finds Deep Field Good Pay

In the new Worland field, 12 miles north of Worland, Wyoming, rigs sprouted on farm land growing crops of grain, alfalfa, and sugar beets. The heavy "adobe" land was considered worthless by neighboring farmers on sandy loam soils next to the hills. About 20 years ago the Holly Sugar Corporation purchased several sections of the flat gumbo land and spent large sums in leveling, subsoiling, and fertilizing the soil.

Crop results probably never have repaid the cost of development, but oil wells flowing 700 to 1000 bbl of high gravity crude from the Embar lime, at 10,000 ft, will more than make up any losses. The few poor farmers who struggled along with the hard clay soil through the years as well as the sugar company, are now beginning to realize handsome dividends from the unexpected source of oil royalty payments.

Although Pure Oil Company opened production in 1946, other operators were quick to follow the play. In 1947 alone Worland had an estimated production of 332,000 bbl. Discoveries such as this at Worland Dome account in part for the bustle of current activity, and the number of major offices now present in the Rocky Mountain region.

NEWS

Superintendent Retires

With a record of continuous service among the highest in the history of the company, C. W. Montgomery, superintendent of transportation at Los Angeles for Standard Oil Company of California, retired on Friday, October 1.

Montgomery joined Standard on January 2, 1902, in the order and distribution department. He made steady progress, and within a few years became general manager of transportation in Los Angeles, and later, head of the field transportation office for the company there.

In May, 1934 Montgomery was made superintendent of transportation, the position he had held until retirement.

Streamlined Magazine

The four Petroleum Engineer magazines to be published beginning in January, 1949, will be:

1. *The Petroleum Engineer*—all divisions. This will include all sections and will be like this issue of the magazine.

2. *The Petroleum Engineer Exploration, Drilling, and Production Magazine,* which will include the first two sections. (In this issue the sections cover Pages 1 to 224.)

3. *The Petroleum Engineer Refining and Natural Gas Processing Magazine,* which will include the General Section (Pages 1 to 112 in this issue) and the Refining and Gas Processing section (Pages 225 to 266 in this issue).

4. *The Petroleum Engineer Pipe Line and Marine Transportation Magazine,* which will include the General Section (Pages 1-112) and the Pipe Line and the Marine Transportation Section (Pages 267 to 308 in this issue).

Readers can now choose the material they want to read without paying for extra baggage. Subscribers should indicate the magazine they prefer to receive after January, 1949, when the new streamlined magazines will be issued.

Directors of Penn Grade Meet

Directors of the Pennsylvania Grade Crude Oil Association laid plans for 1949 activities of the organization at a recent meeting at Bradford.

Membership applications for next year receiving approval included those of 13 refiners of Pennsylvania grade crude oil, 192 jobbers located throughout the United States, and 21 marketers in Europe, Asia, and Australia. Producer memberships are on a continuing basis and total about 300.

D. T. Ring of Columbus, Ohio, association president, conducted the meeting. He was assisted by W. C. Wenzel of Oil City, association executive manager. Directors present included the following from Bradford: D. T. Andrus, George H. Daggett, J. B. Fisher, G. J. Hanks, A. J. Saxe, A. C. Simmons, C. E. Streeter, and John E. Selden.

Other board members attending were F. G. Bannerot, Jr., Charleston, West Virginia; C. A. Chipman, Bolivar, New York; W. F. Clinger and H. A. Logan, Warren, Pennsylvania; F. B. Dow, Washington, D. C.; B. T. Haskins and G. W. Holbrook, Wellsville, New York; D. E. Hoffman, New York, New York; and N. V. V. Munson, Olean, New York; Samuel Messer, W. R. Reitz, A. W. Scott, C. L. Suhr, and W. S. Zehrung of Oil City; J. R. Schmitt, Philadelphia; and S. M. Vockel, Pittsburgh.

Appoints Distributor

Chain Belt Company of Milwaukee announces the appointment of The Continental Supply Company as a distributor for its oil field chains. Stocks of both Rex API chains and Baldwin-Rex roller chains will be available at all the Continental Supply Company's store points.

Chain Belt Company has also opened a district sales office at Midland, Texas.

Dave Breith, newly associated with Chain Belt, will be in charge of this office. Breith, a graduate of Texas A & M, has had extensive experience in the Texas oil fields in the employ of Continental Oil Company, Bethlehem Supply Company, and General Oil Service, Inc.

D + B acquires Mid-Continent distribution of Page Oil tools

Wm. C. Kinder, vice president and manager of the D + B Division of the Emsco Derrick and Equipment Company, is here shown signing a contract with John S. Page, inventor of the Page tension type production equipment and president of the Page Oil Tools, Inc., wherein the D + B Division of Emsco acquired the exclusive distribution of Page oil tools in all fields of the United States, with the exception of the states on the Pacific Coast.

The Page equipment will be stocked in D + B stores and Continental Supply Company stores. These products will be sold and serviced in a manner identical to all D + B production equipment. Production tools developed and made by Page Oil Tools, Inc., have gained wide acceptance in both California and Rocky Mountain areas. Page tools include tubing anchors for anchoring tubing in pre-set tension and parallel string tubing anchors for anchoring both regular tubing and parallel string in pre-set tension. In addition, the company has developed and has in manufacture adjustable pump anchor packers, rotating bottom hole packers, combination tubing drains and bumper subs, bottom hole oil and gas separators, and sucker rod on and off attachments.

NEWS

H. K. Browning Succumbs

H. K. Browning, recently elected vice president of Kobe, Incorporated, Los Angeles, California, died of a heart attack October 26, at his home in Alhambra, California. Neither he

H. K. Browning

nor any of his friends had noted any particular change in his customarily good health. Indeed, he had made all arrangements to leave on the very day of his death for a tour of the Mid-Continent fields, and had planned to take in the API convention at Chicago before returning to Los Angeles. However, he was taken suddenly ill in the early morning and passed away before the family doctor arrived.

"Brownie," as he was popularly known, had risen fast in the Kobe organization since he joined it some eight years ago. He exhibited in a marked degree an administrative knack for tying together all the divers and scattered agencies into a well integrated force, and in addition had a pronounced faculty for making friends.

Tanner to Address Compact

N. E. Tanner, minister of lands and mines, province of Alberta, Canada, will be one of the featured speakers at the Interstate Oil Compact Commission's annual meeting in Wichita, Kansas, December 9-11, it was announced by Governor Beauford H. Jester, Compact chairman.

Mr. Tanner will discuss oil and gas developments in Canada, analyzing present activity and potentially productive areas, reviewing the Leduc field, and emphasizing conservation work.

Annealing Important Corrosion Factor

Corrosion in oil wells can be reduced greatly by using more thoroughly annealed steel for tubing and casing, Dr. P. H. Cardwell of Dowell Incorporated, Tulsa, told a statewide meeting of the American Chemical Society recently at the University of Tulsa.

"Since oil wells are being drilled deeper and deeper and are encountering more and more corrosive fluid, it becomes a requirement to obtain as corrosion-resistant metal as possible," Dr. Cardwell said, "and one way to accomplish this is to have completely annealed metal."

Reporting research on seventeen different steels, he stated that the extent of annealing varied over a wide range. Dr. Cardwell's studies indicate that longer annealing periods help to make steel more resistant to ordinary rusting and to corrosion caused by the hydrochloric acid employed in oil wells.

Ohio Opens Columbus Office

The Ohio Oil Company has opened a district production office at Columbus, Ohio. A part of the Terre Haute, Indiana, production division, the new district office will serve as headquarters for the company's crude oil and gas production operations in Ohio, Pennsylvania, Virginia, West Virginia, eastern Kentucky, and eastern Tennessee.

J. J. McClelland, a veteran of 29 years in the company's production department and formerly located at Owensboro, Kentucky, is manager of the Columbus district operations.

H. G. Walter, who moves to Columbus from Tallahassee, Florida, has been appointed district geologist.

M. O. Johnston in Texas

M. O. Johnston, president of the Johnston Oil Field Service Corporations and The Johnston Enterprises, recently made a business trip by plane from the company's Los Angeles plant to various points in Texas. At Longview he conferred with his partner in The Johnston Enterprises, E. C. Johnston, about Hydra-Line developments.

M. O. Johnston

"M. O." field tested new equipment and spent some time with manager Bill Taylor of the Johnston Oil Field Service Corporation at Houston headquarters relative to formation testing and "Shoot-N-Test" matters.

New Division Managers

Two promotions to division managers for the H. C. Smith Oil Tool Company have been announced by

John Womack

Lew Leidecker

Ronald C. Smith, general sales manager.

Formerly branch manager at Craig, Colorado, Lew Leidecker has been moved up to division manager for Michigan and the Tri-State area. He makes his headquarters at Carmi, Illinois. Leidecker joined the company in 1945.

John Womack has been appointed division manager for Wyoming and will maintain headquarters at Douglas. For the past year he has been assistant branch manager at Vernal, Utah.

Executive Visits Europe

H. John Eastman, president of the Eastman Oil Well Survey Company, whose headquarters are in Denver, left in October for England, France, Germany, Belgium, Holland and Luxembourg, to confer with officials of twelve leading independent oil companies of those regions regarding the problem of supplying them with urgently needed oil tools, equipment, and oil well surveying service for use in prospecting new fields in Europe.

At the explicit request of Werner Mueller, who has the largest oil tool manufacturing plant in Central Europe, Eastman made the trip. He had been advised that his urgent presence was needed due to the American-British authorities requesting the German oil industry to start immediate operations on small bore wildcatting or prospecting work.

The Eastman Company maintained offices in Hanover, Germany, and Ploesti, Roumania prior to World War II.

Bucyrus-Erie Appoints Canadian Distributor

Appointment of Wilkinson and McClean Ltd., of Calgary, Edmonton and Lethbridge, Alberta, Canada, as distributors for Bucyrus-Erie blast hole drills, prospecting drills, and bit dressers was announced recently by Bucyrus-Erie Company, South Milwaukee.

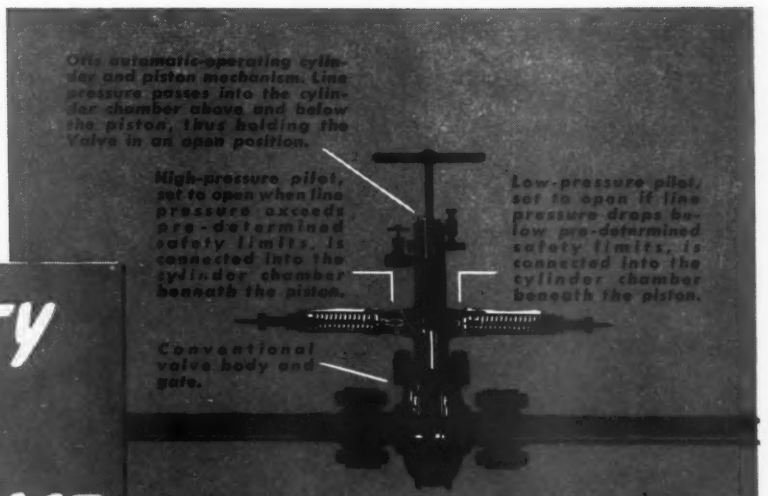
5*

flow line SAFETY in a heavy-duty PACKAGE

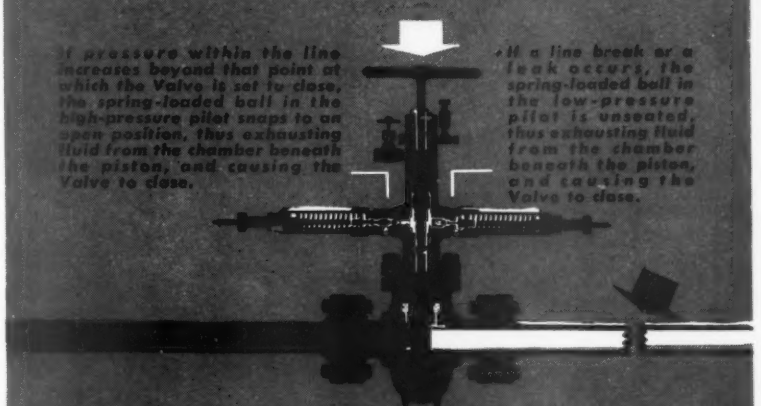
Otis Surface Safety Valves are full-opening pressure-operated gate valves which can be installed on single and two-zone well connections, flow lines, transmission lines, etc., to provide an automatic and positive shut-off when line pressure varies from predetermined high or low limits.

The Valves consist of an Otis Surface Safety Valve bonnet assembly (internal cylinder and piston arrangement) and either a high-pressure or low-pressure spring-loaded pilot valve, or both, combined with a conventional heavy-duty gate valve body and gate. The force which actuates the Valve may be supplied either by pressure from the line in which the Valve is installed, or by pressure from an outside source. The pilots are adjusted to open automatically when line pressure varies above or below an exact selected range. In either case, pilot action causes the piston to automatically drive the valve gate from a fully-opened position to positive shut-off — *the instant safety demands.* (For specific operating details, see diagrams on right.)

If your oil or gas lines are vulnerable to freeze-ups, breaks, leaks, or any other unpredictable condition which might cause pressure variations above or below safe limits, check with the Otis man nearest you. He is well-equipped with facts, figures, and case histories of numerous Otis Surface Safety Valve installations.


Otis automatic-operating cylinder and piston mechanism. Line pressure passes into the cylinder chamber above and below the piston, thus holding the Valve in an open position.
High-pressure pilot, set to open when line pressure exceeds pre-determined safety limits. Is connected into the cylinder chamber beneath the piston.
Low-pressure pilot, set to open if line pressure drops below pre-determined safety limits, is connected into the cylinder chamber beneath the piston.
Conventional valve body and gate.

1. Diagram above illustrates a typical Otis Surface Safety Valve installation. The Valve is composed of a conventional valve body and gate; a bonnet and stem assembly incorporating the exclusive Otis cylinder-and-piston arrangement; and equipped with a high-pressure pilot (left) and a low-pressure pilot (right). These spring-loaded pilots are actuated, respectively, by an increase or decrease in pressure supplied by the line in which the Valve is installed. The complete Valve is self-contained and full-opening. (See Paragraph No. 2 below).


If pressure within the line increases beyond that point at which the Valve is set to close, the spring-loaded ball in the high-pressure pilot snaps to an open position, thus exhausting fluid from the chamber beneath the piston, and causing the Valve to close.
If a line break or a leak occurs, the spring-loaded ball in the low-pressure pilot is unseated, thus exhausting fluid from the chamber beneath the piston, and causing the Valve to close.

2. For example — presume that this Otis Surface Safety Valve is installed on the flow wing of a gas-distillate (corrosive) well which has a flowing pressure of 2100 p.s.i. The well, located in a river bed, is connected to a separator through approximately 200 yds. of exposed flow line, making the line vulnerable to flash floods and high water. The Otis Surface Safety Valve is operated by pressure from within the line. In case the line is broken and pressure drops below 1700 p.s.i. (that for which the low-pressure pilot is set) the low-pressure pilot is actuated, thus causing the gate valve to automatically close to a positive shut-off and remain closed until opened manually. Likewise, in the event the line is subjected to an increase in pressure above 2400 p.s.i., the high-pressure pilot is actuated and the Valve is instantly closed to prevent a line break.

PATENTS APPLIED FOR

***NO. 5** *in a series of high-pressure production problems and practices and the allied use of Otis Surface and Sub-Surface Controls and Services. Reprints of the series, suitable for filing, are available upon written request to Otis Pressure Control, Inc., Box 7206, Department A, Dallas, Texas.*

NEW LITERATURE AVAILABLE

"Otis Wire Line, Pressure Tubing, and Special Services" — a four-page illustrated folder describing the various Otis Wire Line and Pressure Tubing Services and special equipment. Write to address shown above.

PRESSURE CONTROL — OTIS — SERVICE — EQUIPMENT

SURFACE SAFETY VALVE

(T-22)

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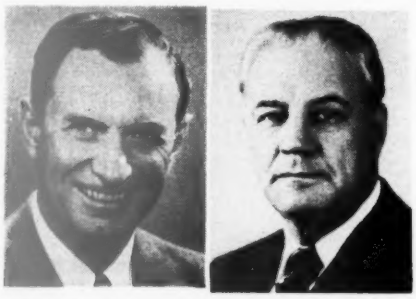
EXPORT SALES AND SERVICES: **OTIS PRESSURE CONTROL EXPORT, INC.,** POST OFFICE BOX 7206, DALLAS, TEXAS, U. S. A.; CARACAS, SOUTH AMERICA

Dunbar, Van Matre Advance

Pacific Pumps, Inc., has appointed Roy A. Dunbar general sales manager, oil well plunger pump division, Huntington Park, California. Ralph C. Van



R. C. Van Matre — Roy A. Dunbar

Matre will succeed Dunbar as general sales manager, oil well plunger pump division, Tulsa, Oklahoma.

Dunbar will make his headquarters at Huntington Park, California. He will be in charge of and will coordinate all sales and service activities of the oil well plunger pump division. Van Matre will assume charge of Pacific Pumps, Inc., Mid-Continent division, a sales and service organization with headquarters in Tulsa, Oklahoma, and stores throughout the Mid-Continent and Rocky Mountain areas.

A. F. Canada, Jr., will continue his duties as Tulsa district manager.

Northeast Arizona Exploration

Lease agreements signed recently by the General Petroleum Corporation, Los Angeles, were the first step in the Company's new program to develop oil production in the State of Arizona.

In one of the largest land deals of its kind, General Petroleum leased a total of 64,000 acres of property in northeastern Arizona from George C. Creager, independent oil producer, the Aztec Land and Cattle Company, and the New Mexico-Arizona Land and Cattle Company. General Petroleum will begin drilling operations immediately on the newly-leased land.

The 64,000 acres are located in Navajo and Apache Counties in an arc around the town of Holbrook, Arizona. One of the largest individual parcels borders on the Petrified Forest National Monument and lies just west of the famous Painted Desert. south of Navajo Indian Reservation.

It is in this area that General Petroleum will drill its first exploratory well. The well will be located in Township 19N, Range 23E of Navajo County. The new leases are located in the Black Mesa Basin area and the first well will be drilled on the so-called Little Carrizo anticline.

This anticline has been recognized as potential oil land since before the turn of the century and was mapped in detail by Dorsey Hager, petroleum geologist, who is associated with Mr. Creager in the General Petroleum Corporation dealings.

Many other local structures of an oil bearing potential are located in the Black Mesa Basin territory and have been covered by General Petroleum leases after extensive investigation by company geologists.

Although Arizona has never produced oil in commercial quantities, it has received attention from the oil industry for several years. This attention has increased recently as the national demand for petroleum products has soared.

Merger

Western Oil and Gas Association, Los Angeles, has absorbed Pacific Coast Petroleum Industries Committee and its functions, the Association's board of directors announced.

The merger is being effected in the interests of eliminating duplications in overhead and effecting a better coordination of the industry's activities.

Under the plan approved by the board of directors, the present committee will be dissolved as an independent entity and a new petroleum industries committee will be created.

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- **To offer Complete Controlled Directional Drilling Service.** We are the originators of controlled directional drilling service, and have the largest selection of patented deflecting tools for every type of control job.
- **To supply Modern Oil Well Survey Service.** As pioneers in oil well surveying, we offer you the finest and largest selection of oil well surveying instruments.
- **To furnish Free Engineering Proposals,** in advance of directional work. These proposals give the operator valuable aid in planning his drilling program.
- **To extend Corex Core Orientation Service** into the Pacific Coast and Gulf Coast areas. A proved and speedy oriented core service is now available to you.

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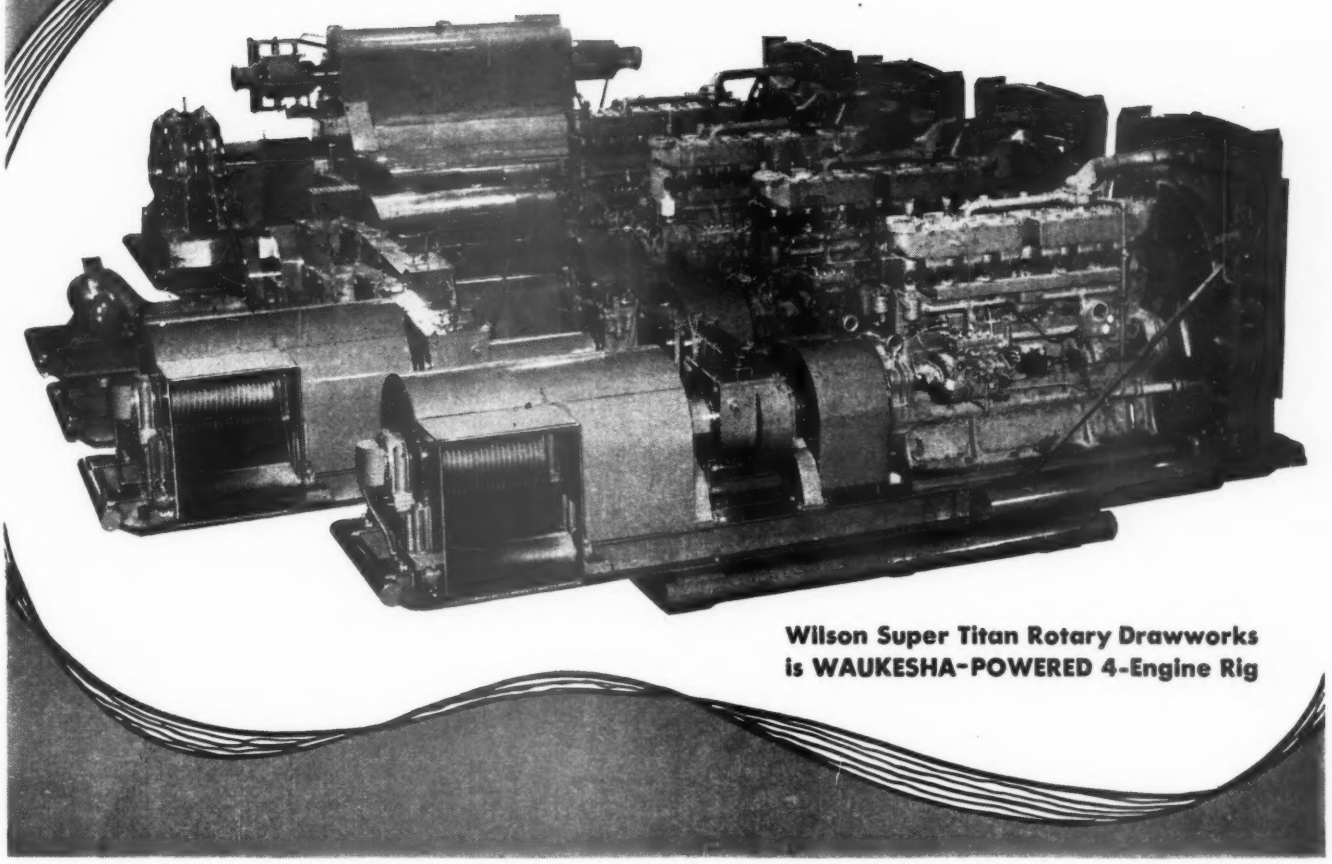


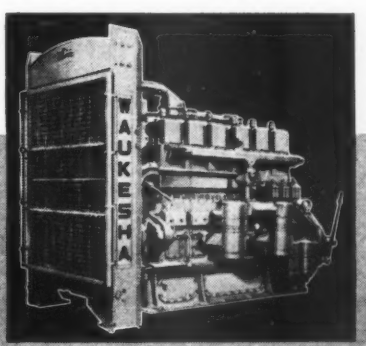
Wilson Super Titan Rotary Drawworks is WAUKESHA-POWERED 4-Engine Rig

● It's a BIG rig—SUPER POWERED for really deep drilling—with four fast flexible Waukesha Power Units. They're smooth and responsive, these Model 6-LROU units—6 cylinder, 8½ x 8½ in. bore and stroke, 2894 cu. in. displacement—developing an aggregate maximum of 1600 horsepower burning natural gas.

Recommended by its makers for drilling to a maximum of 18,000 feet, using 4½ inch drill pipe, the Wilson Super Titan Rotary Drawworks is equipped with two pump drives and a double rotor 40 inch hydromatic brake. Pump clutches, master clutch and rotary clutch are the air tube type. Drum and transmission and catheads are air controlled and the four Waukesha Power Units are equipped with air throttle controls.

Oil field reliability is built into these big 6-LROU units — with removable wet sleeve cylinders, using separate cylinder heads mounting spark plugs and large valves; seven 4¼ in. main bearings; full pressure oiling and every other modern design feature. Get Bulletin 840.

Left (carburetor) side
MODEL 6-LROU
gas or gasoline power unit.



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NEWS

AGA Elects

D. A. Hulcy, president of Lone Star Gas Company, Dallas, Texas, was elected chairman of the natural gas department and second vice president of the American Gas Association, at the New Jersey meeting last month.

Members reelected for a two-year term on the managing committee were: F. C. Brown, Natural Gas Pipeline Company of America; E. Buddrus, Panhandle Eastern Pipe Line Company; Paul Kayser, El Paso Natural Gas Company; F. H. Lerch, Jr., Consolidated Natural Gas Company; E. P. Noppel, Ebasco Services, Inc.; F. T. Parks, Public Service Company of Colorado; C. P. Rather, Southern Natural Gas Company; and Gardiner Symonds, Tennessee Gas Transmission Company. Paul R. Taylor of Stone and Webster Service Corporation was elected to replace Hulcy on the committee.

Robert W. Hendee, retiring chairman of the managing and advisory committees appointed a program committee for the 1949 spring meeting with E. F. Schmidt, Lone Star Gas Company, Dallas, Texas, as chairman. The committee is open to suggestions as to topics and speakers.

Oilwell promotions

The appointment of C. O. Green, manager of Oil Well Supply Company's store at Taft, California, for the past 34 months, to field representative in the San Joaquin Valley district was announced by Warner F. Parker, this U. S. Steel subsidiary's California division manager. Named to succeed him was F. S. Osborn, storeman in the Taft store.

Green, who will continue to headquarter in Taft in his new position has been connected with "Oilwell" for 23 years. At the time of his appointment as Taft store manager in November, 1945, he was manager of the Ventura, California, store. Prior to that, he was a field salesman at Bakersfield.

Osborn, an Army Air Forces veteran, joined Oil Well Supply as a storeman in the Los Angeles store in July, 1945, following his discharge as a technical sergeant. He transferred to Taft as storeman in December of that year.

Oil Base Drops Koebelite

George Miller, president of Oil Base, Inc., manufacturers of Black Magic oil base drilling fluid, announced that Oil Base is no longer distributor for Koebelite diamond bits and core barrels.

Orville Adams, Sr.

Orville Adams, Sr., Dies

Orville Adams, Sr., who died recently, was the author of many articles on diesel engines, many of which appeared in *The Petroleum Engineer*. He was employed in Dallas with the Guiberson Corporation on diesel engine design and development for several years. When the war broke out, he joined the Navy, where he served as Lieutenant Commander—much of the time in Alaska. When the war ended, he became technical editor with Prentice Hall, book publishers in New York. He was called back into service in August of this year and was on duty in Providence, Rhode Island, when he died. He was a native of Kentucky.

Committee on Manpower

The Chairman of the National Petroleum Council, Walter S. Hallanan, recently announced appointment of a Committee on Petroleum Industry Manpower to study, estimate and report on the present manpower engaged in the petroleum industry and to consult with representatives of appropriate governmental agencies regarding the needs of a study of essential manpower requirements of the petroleum industry during an emergency, if one should arise.

The Committee is asked (1) to study, estimate and report on the present manpower engaged in the industry, classified by functional divisions of the industry occupations and skills and geographic areas; (2) to study and report as to the adequacy of currently available employment data for the functional divisions of the domestic petroleum industry and to recommend ways and means of overcoming such deficiencies as may exist therein.

W. W. Vandeveer of Cleveland, Ohio, has been designated Chairman of this important Committee, members are as follows: John A. Bartlett, American Mineral Spirits Company, Corpus Christi, Texas; Burt R. Bay, Northern Natural Gas Company, Omaha; E. W. Berlin, Standard-Vacuum Oil Company, New York; Sidney Belither, Shell Oil Company, Inc., San Francisco; Jacob Blaustein, American Trading & Production Corporation, Baltimore; George F. Bush, Mid-Continent Petroleum Corporation, Tulsa; S. A. Candee, Tide Water Associated Oil Company, San Francisco; Robert Dailey, Humble Oil and Refining Company, Houston; John C. Day, Western Petroleum Refiners' Association, Tulsa; John Ferguson, Independent Natural Gas Association, Washington, D. C.; John W. Frey, American Petroleum Institute, Washintgon, D. C.

And, Robert W. Hendee, Colorado Interstate Gas Company, Colorado Springs; Howard P. Holmes, Two-State Oil Company, Dallas; Carl A. Johnson, Holly Development Company, Los Angeles; L. Dan Jones, Independent Petroleum Association of America, Washington, D. C.; W. M. Keck, Jr., The Superior Oil Company, Los Angeles; John M. Lovejoy, Seaboard Oil Company of Delaware, New York; W. D. Mason, Sun Oil Company, Philadelphia; Robert S. Newhouse, Stanolind Oil and Gas Company, Tulsa; Donald P. O'Hara, National Petroleum Association, Washington, D. C.; D. T. Pierce, Sinclair Refining Company, New York; Kenneth Schaffer, Standard Oil Company of California, San Francisco; W. F. Sehmann, National Stripper Well Association, Wichita Falls, Texas; Charles Shaw, Standard Oil Company, (New Jersey), New York; James Tanham, The Texas Company, New York; and, H. L. Thatcher, Chattanooga, Tennessee.

Opens New Store

Bethlehem Supply Company has recently opened a new store at Cisco, Texas. Personnel changes include:

Jack Morris, formerly store manager and field representative at Wichita Falls, transferred to Cisco in the same capacity;

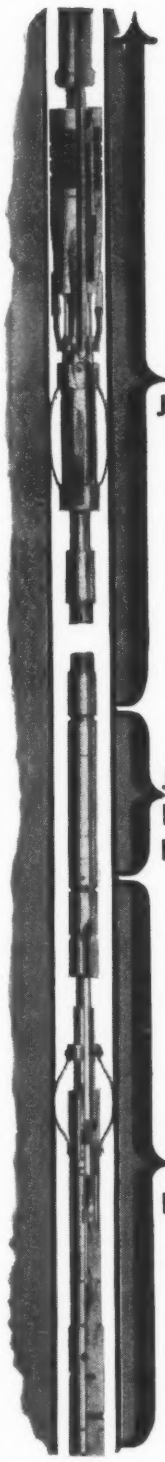
C. A. Pigg, formerly located at the closed Bowie, Texas, store, transferred to Cisco where he will concentrate on sales work;

M. E. McKelvey, formerly assistant store manager is now store manager at Wichita Falls;

J. W. Haney promoted to field representative, Wichita Falls;

C. L. Leger recently joined Bethlehem as a field representative at New Iberia, Louisiana;

B. W. Peeples, new field representative at Odessa, Texas.



MEMO TO:

Johnston Formation Tester OWNERS and OPERATORS

By unitizing a Johnston "SHOOT-N-TEST" Gun Perforator with your regular Johnston Formation Tester Assembly, any designated formation can be both perforated and tested in one round trip of tubing or drill pipe. The "SHOOT-N-TEST" Gun Perforator is easily connected to Johnston test equipment for combined Perforation and Test operations. Simple top-hole manipulation of the string by the driller prepares the Gun Perforator for firing -- existing hydrostatic pressure in the well trips the firing mechanism.

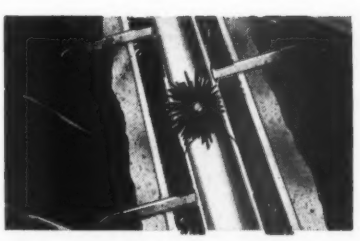
The Johnston "SHOOT-N-TEST" Gun Perforator has the versatility to be used solely as a casing perforator or as the perforating unit in combined perforation and test operations. Its design embodies many advanced features to make it the ideal choice for operators desiring the utmost safety and efficiency in perforation equipment.

THE JOHNSTON SHOOT-N-TEST GUN PERFORATOR

The Johnston "SHOOT-N-TEST" Gun Perforator connected to a regular Johnston Pressure Recorder and Formation Tester permits both casing perforation and formation test in a single trip of tubing or drill string.

"SHOOT-N-TEST" with the JOHNSTON All-Purpose GUN PERFORATOR Offers These Features

- SAFER GUN OPERATION
- POSITIVE FIRE OF ALL BULLETS
- ANY NUMBER OF PERFORATIONS
- EXACT POSITIONING in test zone
- MINIMUM NUMBER OF EXPENDABLE PARTS
- FAST, EASY MAINTENANCE



Fully patented—covered by Patent Nos. 2,073,107, 2,189,919, 2,126,641, 2,129,216, 1,901,813, 2,161,233, 2,176,766, 2,218,988, 2,186,488, 2,307,360, 2,305,139, 2,295,634

SHOOT-N-TEST Trademark JOHNSTON FORMATION TESTING

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LAUREL, MISSISSIPPI • MAGNOLIA, ARKANSAS
CHICKASHA, OKLAHOMA

EXPLORATION ACTIVITIES

Completes New Wells

The foremost of Sunray's new wells is the Davenport-State No. 1, a wildcat in Starr county, completed recently for 144 bbl per day through 10/64-in. choke. Sunray owns 100 per cent interest in 1400 acres of Slick Estate lands offsetting the Davenport-State lease to the north and west, and plans further development immediately. Sunray's Slick Estate "B" No. 1 was drilling at 4522 ft.

Dr. Garcia B No. 1, Share 4, San Jose grant, Starr county, was completed for 142 bbl daily through 9/64-in. choke. This well is the company's second completion on a 926-acre lease, extending the La Reforma field of Starr county. In Goliad county, bbl per day potential through ¾-in. Hancock survey A-142, Sunray's Albrecht No. 4 was completed for 107 choke.

General Petroleum Opens Land Offices

In an extension of the activities of the land department of the General Petroleum Corporation, four district offices have been established by the department in Bakersfield, Ventura, San Francisco, and Los Angeles. Ralph F. Acker has been appointed assistant manager of the department. Assisting him is H. B. Lathrop. They will make their headquarters in Los Angeles.

The four district offices will be headed by: W. Paul Carver, Bakersfield, for the South San Joaquin area: Charles F. Sawyer, Ventura, for the Coastal district; Frank J. Gaspar, San Francisco, for the Sacramento and North San Joaquin area; Parke W. Jackson, Los Angeles, for the southern area of the state.

Acker, a veteran of more than 20 years service with GP, has been land agent for the company in Los Angeles since 1943. His previous oil experience includes engineering and geophysical work. Lathrop has been with the Company since 1932. He began as a messenger and the following year advanced to a clerk in the land department, later becoming a leaseman in the Los Angeles and Bakersfield offices of the company. Carver joined General Petroleum as a clerk in 1938 and became a leaseman in 1945 after having served for two years as chief clerk in the legal department.

Sawyer has been leaseman since he joined the company in 1943. Gaspar came to General Petroleum from an affiliate company. He has recently served as a real estate representative in the San Francisco area. Jackson joined General Petroleum in 1919 as a chainman. From 1923 to 1942 he served as an instrument specialist in the company's engineering department. He became a field engineer in 1942 and a leaseman in 1948.

Discovers Wyoming Field

Phillips Petroleum Company's recent wildcat discovery well, Cole Creek No. 1, located about 18 miles east of Casper, Wyoming, was reported to have flowed 346 bbl of 35.2-deg API gravity sweet oil through perforations in the basal 26 ft of a 35-ft thick Lakota oil sand topped at 8285 ft.

This new discovery well in 17-34N-76W, Converse county is located in the approximate center of the company's 4900-acre South Cole Creek Federal Unit.

During the drilling of this well a drillstem test indicated that the overlying Dakota sand will also be productive of sweet oil.

Sunray et al Acquire Canadian Prospects

Sunray Oil Company, two other American Oil companies not named, and Canadian oil interests recently acquired a government concession to prospect and drill for oil on approximately 4,000,000 acres in Alberta Province of Canada. The Sunray company is a wholly-owned subsidiary of Sunray Oil Corporation.

Sunray and its American partners have acquired a 60 per cent interest in the property. Pacific Petroleums, Ltd., headquartering in Calgary, Alberta, and its associates in 20 companies, each holding limited acreage, have a 40 per cent interest in the project.

C. H. Wright, president of both Sunray Oil Corporation and Sunray Oil Company, announced here that the company would probably establish offices at Calgary. The operating unit will be known as the Bear Oil Company, and exploration and drilling personnel will be announced later as the organization is in the process of formation at the present time.

Beginning around the town of Athabaska, the acreage under lease by Sunray and its associates extends northeast and north along the Edmonton railroad to Waterways, thence with a tip extending northward along the river almost to the town of Mackay; and from Waterways southwest and south along the Athabaska River back to Athabaska; forming a rough oval of continuous acreage. The group has also acquired a separate block of about 500,000 acres along the south side of Lesser Slave Lake, and another semi-isolated block of about 250,000 acres east of Mistahae Lake, which includes part of both North and South Wabiskaw lakes.

The American-Canadian associates contemplate an immediate exploration program with extensive gravity crew work in the 200-mile long area, working a float trip the entire route of the Athabasak River. The company also contemplates drilling 20 to 30 test wells in the initial phase of the development program.

Southwest of Athabaska extensive gas fields have been located, and Pelican Rapids on the Athabaska River in the center of one block of the company's acquisition has been proved for natural gas production. Interest in the northern Alberta area under lease by Sunray and its associates was greatly intensified by the recent announcement that Imperial-Redwater No. 1, SE SE 32-57-21w4 in Alberta has been brought in as a producer, flowing 1728 bbl of oil per day on drillstem test. The well is in the Devonian lime at 3110 ft, and is about midway between the prolific Leduc and Woodbend fields and the town of Athabaska.

Phillips Completes Garvin Outposts

Phillips Petroleum Company's No. 1 Nesbitt, outpost well in Garvin county, Oklahoma, flowed at the rate of 650 bbl of 42½-deg API gravity oil per day through ¼ in. choke during initial 19 hr test of 41 ft of Hart sand pay topped at 8043 ft.

This new producer is located in the SE SE NW, 34-3N-3W, ¾ mile north of recently developed Hart sand production, and 3 miles west of the Southwest Antioch field. The company owns 1535 acres in the immediate vicinity of this well and also considerable additional acreage in the area.

NEW DRILLING RECORDS with GM DIESELS

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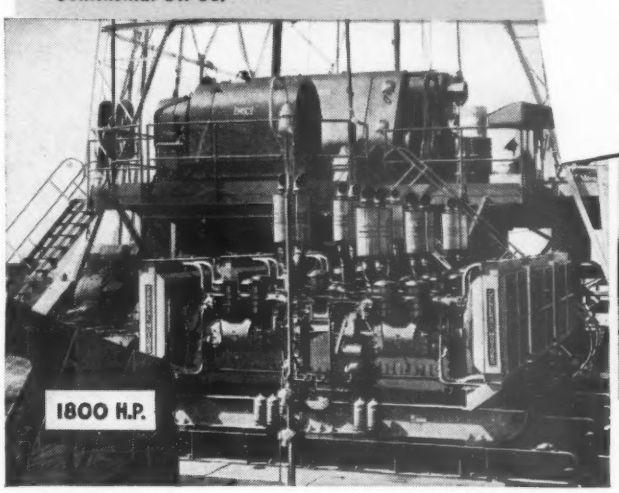
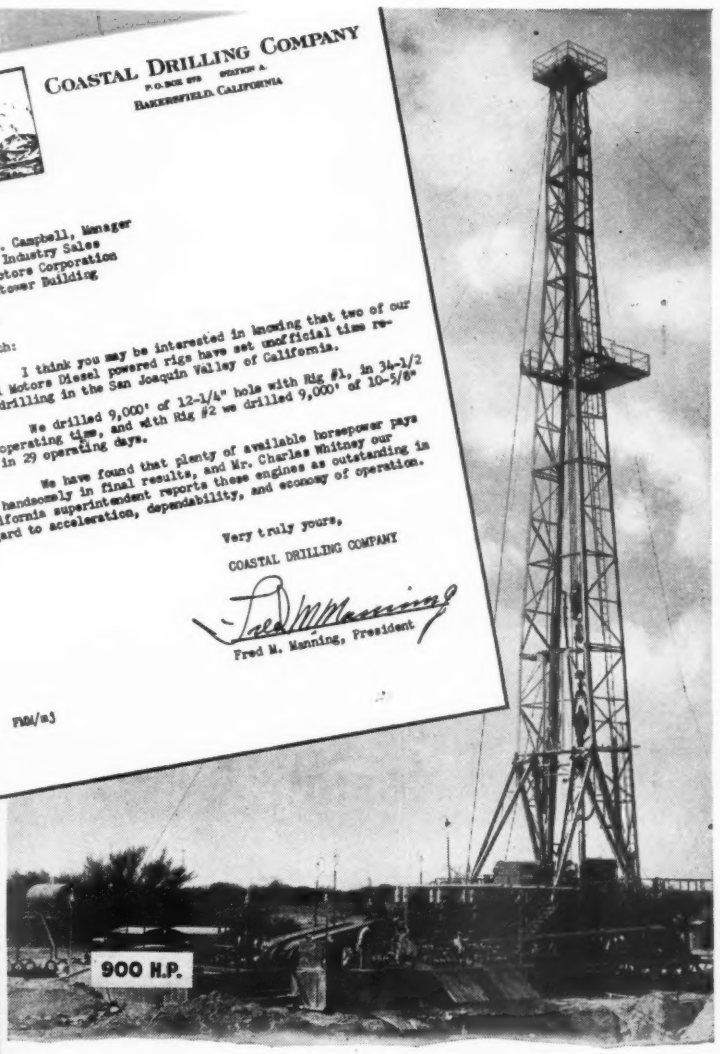
We have found that plenty of available horsepower pays off handsomely in final results, and Mr. Charles Whitney our California superintendent reports these engines as outstanding in regard to acceleration, dependability, and economy of operation.

Very truly yours,
COASTAL DRILLING COMPANY
Fred M. Manning, President

FMM/mj

Emsco J-1250 power... by 2 GM Quad units (1800 H.P.) drilling in San Joaquin Valley for Continental Oil Co.





Three GM Twins (900 H.P.) powering an Emsco J-760 rig drilling for Continental Oil Co. under a Lee C. Moore mast in Southern California.

BACK of the splendid service Mr. Manning writes about are the fundamental features of GM Diesel design which have won these engines the acclaim of drilling contractors everywhere.

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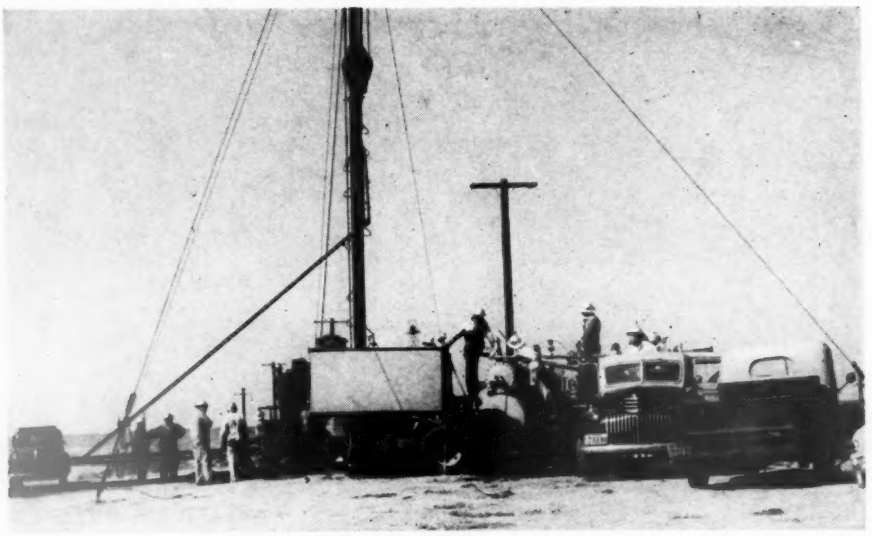


EXCLUSIVE

Cementing equipment, which was perfected for application with Portland cement, is ideal for plastic resins when a special supplementary mixer is used.

Plastic Resins Used With Oil-Base Mud

By ORIE O. DALE*

THE oil industry has made considerable advancement in developing drilling fluids during recent years. These developments have resulted from considerable work on the part of many men who have specialized in applying the sciences of chemistry, physics, and ceramics to the practical problems connected with the use of drilling fluids in boring for oil. Such developments have made possible faster drilling, deeper drilling, fewer and less expensive fishing jobs, and less damage to producing zones.

The fact that certain types of drilling fluids can do serious damage to oil-producing zones is generally recognized. Particular emphasis is placed on thin mud filter cake of low water loss when drilling through oil zones with water-base colloidal drilling fluids. Many methods have been devised to remove these filter cakes on completion of the well, including mechanical, chemical, and hydraulic processes.

It is also generally recognized that an ideal drilling-in fluid consists mainly of oil of the type to be produced from a given zone and should contain a minimum amount of materials incompatible to the zone, such as waters, clays, or other foreign materials. First developments in this field were the use of oils of various viscosities and specific gravities as a circulating medium. The need for additional weight to control formation pressures and the need for filler materials to control fluid losses led to the development of oil-base muds, several types of which are presently being used. In general an oil-base drilling fluid is made up with oil as the suspending fluid for the particles of filler and/or weight material.

The industry early recognized that difficulties might be encountered if standard practices of cementing with Portland cement were attempted in this new circulating medium. Experience soon proved that these suspicions were well founded. It is commonly believed that Portland cement does not bond well to an oil-wetted or saturated surface. Oil contamination can prevent proper setting or crystallization of cements of the Portland type. The use of excessive amounts of Portland cement over the volume required to cut down the percentage of contamination and the resultant scouring effect of large quantities of this material was found to be a partial solution to the problem. Other aids such as mechanical scratchers and washing fluids were found to be of benefit. Because in many instances there was much to be desired in the results obtained, other materials were sought for use in solving these cementing problems.

Plastic resins were known to have certain properties that indicated their effective use in oil-base drilling fluids. These resins are the "Bakelite" type of thermosetting plastics of phenol-formaldehyde composition. The resins were developed, and had been effectively used, for a period of several years to cement off unwanted fluids in oil wells. Many practical applications over this period of years proved that the preferential wetting action of the plastic over oil or water improve the prospects for good bonding. The plastic is less subject to contamination by oil; therefore, it would be less adversely affected by oil-base drilling fluids.

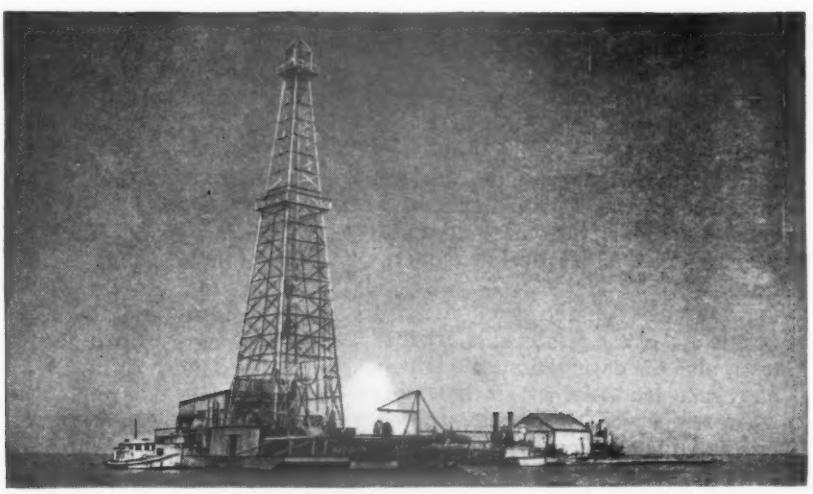
Laboratory tests were conducted with plastics and oil-base drilling fluids. These tests were designed to simulate anticipated well conditions insofar as possible, and the results of all experiments pointed to the effectiveness of plastics as a solution to these specialized problems.

A point of interest was noted when plastic was intimately mixed with an

*Plastic supervisor, International Cementers, Inc.

DEPENDABILITY

THROUGH RESEARCH



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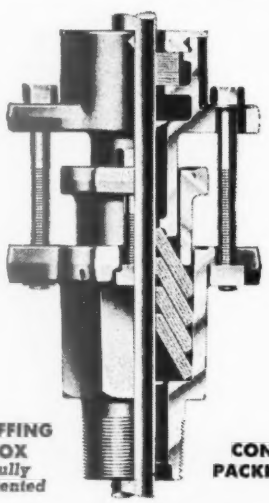

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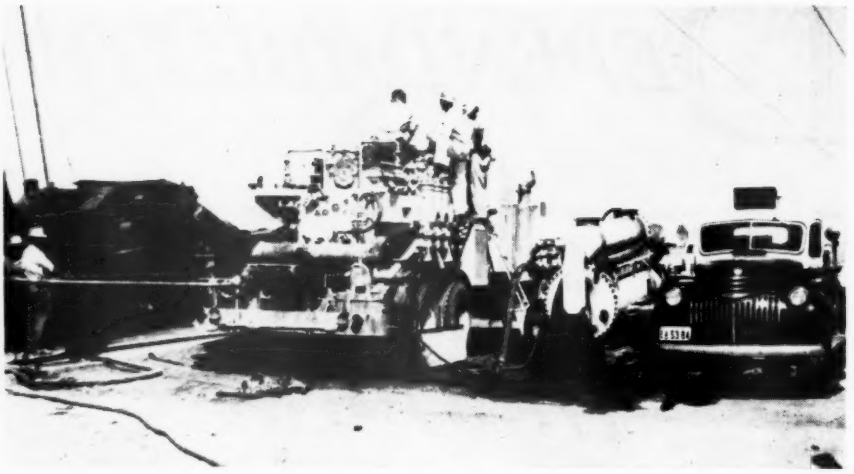

High pressure cementing equipment is used to pump the plastic resins from the portable auxiliary mixer shown beside the cementing unit.

oil-base fluid. The fillers, used to prevent loss of fluid to the formation and add weight to the oil-base mud, were absorbed by the plastic to increase its volume, add weight to the plastic, and increase the strength of the final set mix. The oil was liberated as a separate phase. This phenomenon has also been observed in practical field operations.

Knowledge of the properties of plastic and of the results of laboratory tests, plus the desperation of an operator, soon led to its use in cementing where an especially difficult problem was anticipated. The plastic was soon tried for bottom plugging, cementing off c.p. (cementing point) ports and liner laps, and the cementing of short blank section of liners that were placed between perforated intervals. The usual time required with Portland cement was about 48 hr per job. The setting times obtainable with the plastic resins (1 to 2 hr) made the material economically desirable because of the saving of time on any given number of jobs.

When put to use the plastic resins proved to have greater value than fast setting time. A satisfactory test was often obtained after the first operation.

Bottom plugging has been done by means of the bailer method of application and by pumping through tubing. The positive displacement dump bailer can be used to place quickly and accurately small quantities of plastic. It is obvious that the well fluids should be thinner and lighter than the plastic when the plastic is dumped with the bailer. When larger quantities are to be used, or when well fluids are thick and heavy, it is generally more expedient to pump and displace the plastic through tubing. Portland cement is sometimes used in conjunction with plastic where an extremely long plug is desired. The cement plug is purposely left 20 to 30 ft low and then a cap of plastic is applied for the final seal to insure an effective job.

When the liquid plastics are to be pumped or squeezed, such as through c.p. ports or for other purposes, the same tools are used that have become accepted as standard for cementing with Portland cement, i.e., retainers, straddle tools, etc. Rubber plugs with wiping lips are used to prevent contamination of the plastic and to wipe the plastic from the walls of the tubing. One plug is placed ahead of the plastic and one plug is placed behind the plastic. These rubber plugs are trapped in a plug catcher, which is placed immediately above the other cementing devices being used. The device used to trap the plugs consists of a simple perforated extension tube that is encased by an outer tube. The outer tube is an integral part of the run-in string and carries the fluids on toward the other tools. One type of plug catcher tool is equipped with a shear pin arrangement that indicates the arrival of the plugs by pressure increase. Added pressure shears the pins to allow bypassing of fluid through the tool.

A new terminology has entered the oil man's vocabulary since the adoption of plastic resins. A well that is cemented with plastic is "plasticized." The cementing point or cementing ports have heretofore been referred to as "c.p." point. Since the introduction of plastic for cementing we now hear of a "p.p." point.

A sufficient number of short blank section liners have been cemented with

A — ALUMINUM BREAKER BOX — mounts 7 ft. below 1st girth. Provides electrical outlets with individual circuit breakers rated 20 amps at 115/125 volts A. C. or D. C.

B — VPL-G VAPOR-PROOF LAMP — 30° lamp line junction into Derrick leg cable. Note outer metal guard and protective inner glass globe.

C — GANG BOX — mounts 7 ft. below 1st girth. Provides six electrical outlets for Derrick light lines, extensions, etc. Sturdy metal housing with spring loaded covers.

D — TAP OFF BRANCH — used to connect "Fourble Board" line to cable on Derricks leg.

E — FSC FEMALE OUTLET — accommodates lamp socket (F) on Weather-Proof String-a-lite Assemblies molded of Neoprene into Derrick leg cable.

F — ERS LAMP SOCKET — used in FSC Weather-Proof String-a-lite Assemblies (see E). Accommodates standard Edison medium based bulbs.

G — B2A187M MALE PLUG — PUSH-LATCH style with Water-Seal. Hook type coupling connects easily, prevents accidental disengagement.

H — B2A187F FEMALE PLUG — PUSH-LATCH style with Water-Seal. Hook type coupling connectors easily prevents accidental disengagement.

I — VAPOR-PROOF FLOODLIGHT — 200 watt with rigid clamp for mounting. 7' cord has PUSH-LATCH type end connector.

Consult a Joy Engineer

or your nearest Joy office for further information on MINES package Derrick String-a-lite assemblies.

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• One man can easily handle this compact, lightweight Type "B" Tubing Spider. You won't have to use a sledge hammer to dislodge the slips because their narrow backs fit the tapered bowl at any normal setting level. Slips have ample size—won't crush or damage tubing. Will fit rotary table or bolt to well head; has removable gate to place around tubing.

Type "B" is available with 5 slip sizes, 1" to 3". Other Guiberson Spiders are the automatic "Medium" and "Heavy" Types. For complete data see the Composite Catalog, Pages 1540-44.

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The portion of liner shown (right) had been plasticised by dumping the plastic with a positive displacement bailer. The plastic had penetrated through the perforations and they were uniformly sealed with set plastic. The operator experienced no difficulty in removing this liner.

At one time it was general practice to remove and replace liners which had become eroded like the one shown. Now it is becoming standard practice to effect a repair of these conditions with plastic in the immediate area of erosion.

plastic, where oil-base mud was the circulating medium, to warrant the conclusion that this combination is effective. An outline of a typical job in the Wilmington, California, oil field might be of more than passing interest:

Liner: 5½-in., 17-lb combination of perforated pre-gravel-pack and blank.
Hole size: 7⅞ in.
Height to be filled with plastic: 88 ft.
Plastic used: 100 gal. Low heat range plastic with fillers.
Setting time of plastic: 2 hr.

The plastic cement job was tested within 4 hr after the plastic was in place. Twenty-four hours from the time the liner was made up to be run the tubing was landed preparatory to completion of the well by swabbing in.

Cost for plastic and the cementing unit for placement was approximately $1000.

Cementing with Portland cement in oil or oil-base is often extremely difficult. Contamination of the slurry by oil can weaken the cement and prevent its proper setting.

It should be noted that the same characteristics that make plastics advantageous for sealing off oil-wet sands (their good bonding properties) are apt to cause difficulty where the plastic is applied close to an oil-producing sand. If considerable care is not used in placing the plastic accurately, all or part of the oil-producing zone may be sealed off by the plastic.

Filler materials are mixed with the plastic to control its penetration into an oil sand. These filler materials are composed of a grind of various materials that form an impervious filter cake at the sand interface. Tests have been made to determine the proper quantities of filler materials to be mixed with the plastic to control the depth of penetration of the plastic. Penetration of the plastic into a given sand is a function of pressure differential in relation to the quantity of filler material admixed with the plastic, therefore easily controlled.

The potential value of plastic resins as cementing material lies in the fact that:

1. The material is not sufficiently contaminated by oil to affect its setting.
2. Good bonding is obtained in the presence of oil.

* * *

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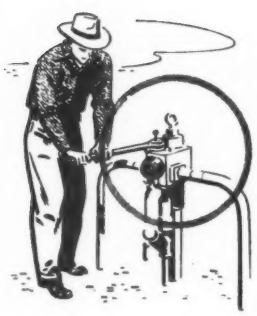

When it is necessary to pull your well, do you have to wait days for service equipment to reach you? Have you figured how much oil you lose just waiting for a pulling rig?

If you have, you'll appreciate the advantages enjoyed by the *Free Pump* operator. His *pulling unit* is always handy. It's right at the wellhead. A turn of the 4-Way Valve handle is all that is needed to surface the bottom hole pump from any depth. It is seated the same easy way.

With *Free Pumping*, there's no waiting for equipment. No pulling expense. No rigging up or tearing down time. Your well is off production only the short time it takes to circulate the *Free Pump* in and out of the well.

Your lease is made independent of uncontrollable factors ...the weather...condition of the roads...availability of equipment.

Eliminate the delays...the waiting...the lost production ...the unnecessary down-time. Keep your *pulling unit* handy by changing to *Free Pumping*. Your local Kobe representative has some interesting figures on the saving you can make when you switch to *Free Pumping*. Call him tomorrow.

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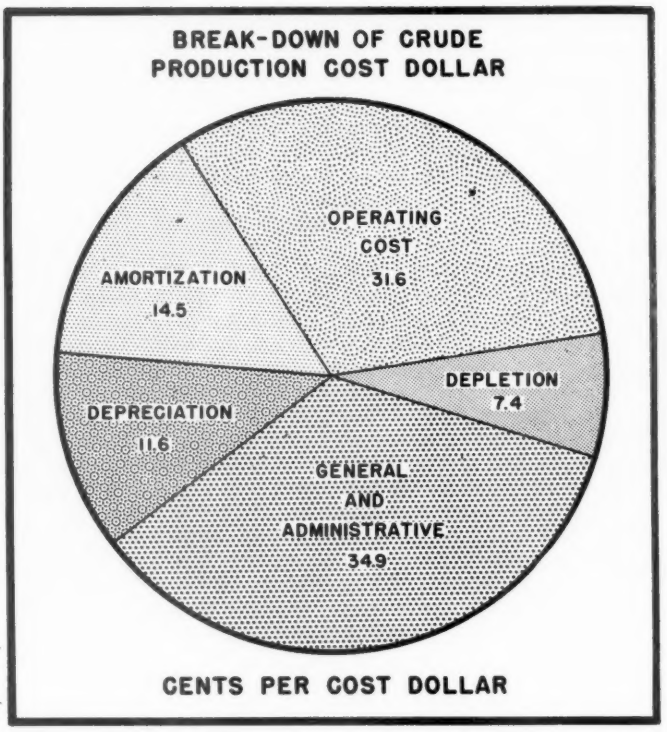
THESE ARE THE DAYS OF FREE PUMPING

TYPICAL U. S. CRUDE OIL LIFTING COSTS

YEAR 1947

(Cents per Barrel)

State	Range*		Average
	Low	High	cost*
Arkansas	12.6	68.3	29.1
California	21.1	31.0	25.1
Illinois	18.0	43.8	30.9
Kansas	23.2	64.0	38.8
Kentucky	(NR)	(NR)	71.0
Louisiana:			
North	15.0	51.0	33.0
Gulf	22.0	25.0	23.5
Michigan	(NR)	(NR)	45.0
Mississippi	(NR)	(NR)	24.0
New Mexico	(NR)	(NR)	27.0
Oklahoma	9.0	65.6	35.2
Texas:			
North and West Central	36.0	110.5	57.6
Gulf Coast	9.0	30.0	18.5
Other	12.0	132.4	39.4
11 States	9.0	132.4	30.3†



Operating and overhead costs = 66.5% production cost.

*Reported cost of lifting to surface by natural or artificial methods only. Does not include costs of supervision, repairs, replacements, reconditioning wells, overhead and capital charges. This represents about one-third of total cost of producing oil.

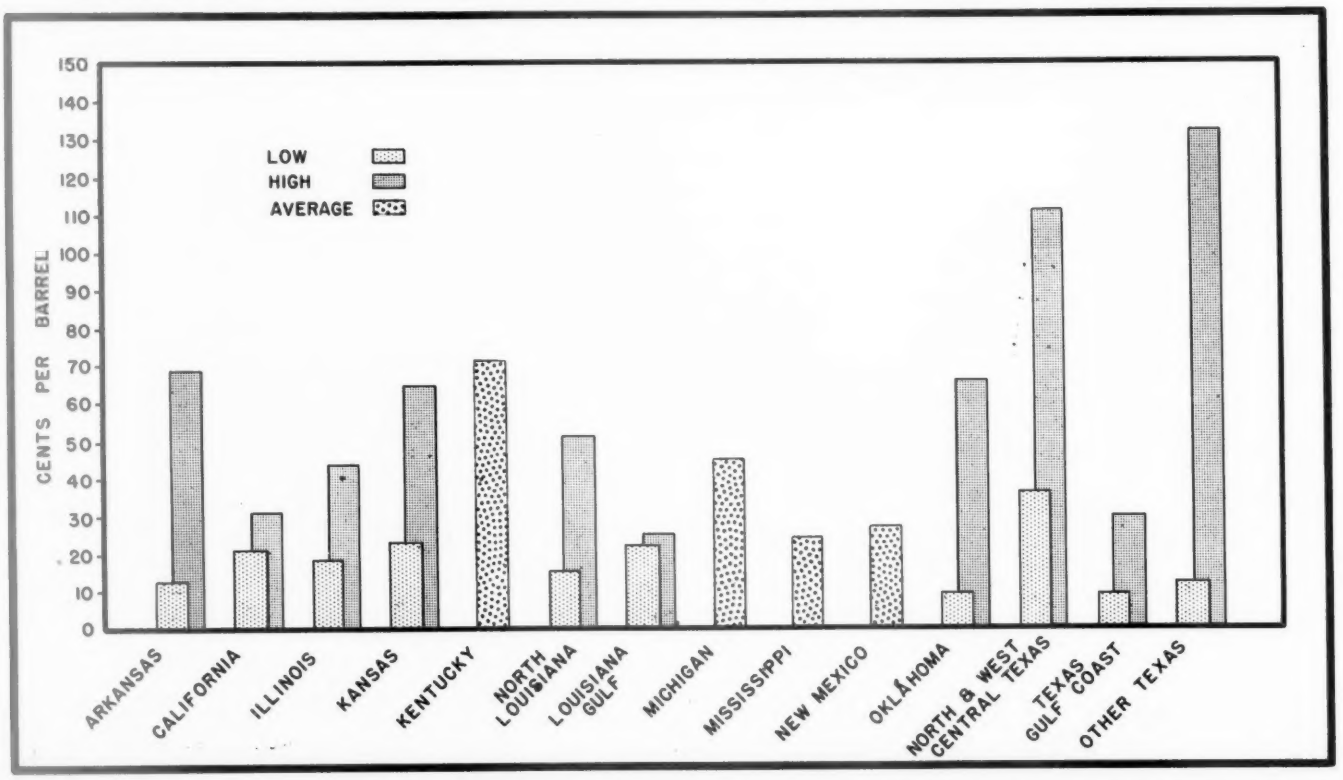
†Weighted average—arithmetic average is 45.3 cents.

(NR)–Not reported—over-all averages only.

Source: Data obtained from book records of major and independent oil producing companies.

CRUDE OIL LIFTING COSTS

Lifting costs vary in every field—averages not indicative of industry's economic position as related to price of crude.



From The Petroleum Data Book, Second Edition, which carries 750 pages of information on the petroleum industry.

On the floor of Victory No. 1 is Frank Bartee, associated with Rocky Jerman (right) in the Signal Hill venture.

New Try Made for Signal Hill Deep Zone

By RICHARD SNEDDON, *Pacific Coast Editor*

THE sporadic boom town of Signal Hill, California, may boom once more —and soon, if the optimism and persistence of R. W. "Rocky" Jerman, pioneer operator, achieve the results they so well deserve. Back in 1938, Rocky discovered the De Soto deep zone, creating lots of excitement in the neighborhood of the Hill, and the fact that it wasn't named the "Jerman" zone is a tribute to the modesty of its discoverer. In any case the De Soto well was located 583 ft north and 75 ft east of the corner of Gundry and Burnett Streets, and it came in on December 13, 1938, on gas lift, for 300 bbl daily of clean 29° API oil. The well was completed at 10,158 ft, with 422 ft of 5-in. liner, including 395 ft of perforations, set on bottom. The top of the producing zone was 9760 ft.

That well when it was brought in was believed to open great new possibilities, although it was drilled in the face of a pretty general skepticism. It wasn't that the operators had any doubt of the existence of a deep zone, but drilling in the Signal Hill area was conceded to be more than usually costly, and it wasn't thought to be economical to go after a deep sand there, when production could be more speedily and less expensively acquired elsewhere. Rocky Jerman was not to be turned away from his conviction, however, that the discovery of a deep zone would be beneficial to many of the operators on the Hill, and hence a deep drilling project might be shared by them. After a period of strenuous missionary work, he had enlisted enough financial and moral support for his plan, and the De Soto Oil Company was formed, with results in the first deep zone try as already indicated.

Now, in view of the high drilling cost, 300 bbl a day—production has since dropped to 50 bbl a day—was not sufficient to stimulate any extensive exploitation program, but it was just big enough to tantalize a good gambler. It certainly didn't discourage Rocky Jerman, for exactly one year later, on December 13, 1939, we find him in the news again with another completion in the same zone, this time, Dormax No. 1. This well was located just northeast from the center line of Twenty-fifth and Gaviota Streets, and came in, on gas lift also, for an estimated 350 bbl daily of the same gravity oil as that produced from the De Soto well. Total depth was 10,442 ft, with a 5-in. liner, including 805 ft of perforations, landed on bottom. This well opened up about twice the thickness of producing zone that the De Soto accounted for, and at the present time is still yielding approximately 100 bbl a day. According to reports emanating from the field at the time of the completion, the deep horizon largely consisted of shale with streaks of hard, tight sand, which were capable of building up high shut-in pressures, but when opened up did not release fluid rapidly enough to cause it to flow freely into the hole.

Naturally, the results of this project left some doubts in the minds of the Signal Hill operators, but R. W.

EXCLUSIVE

HOW TO STOP THE HIGH COST OF HIGH MUD LINE PRESSURES

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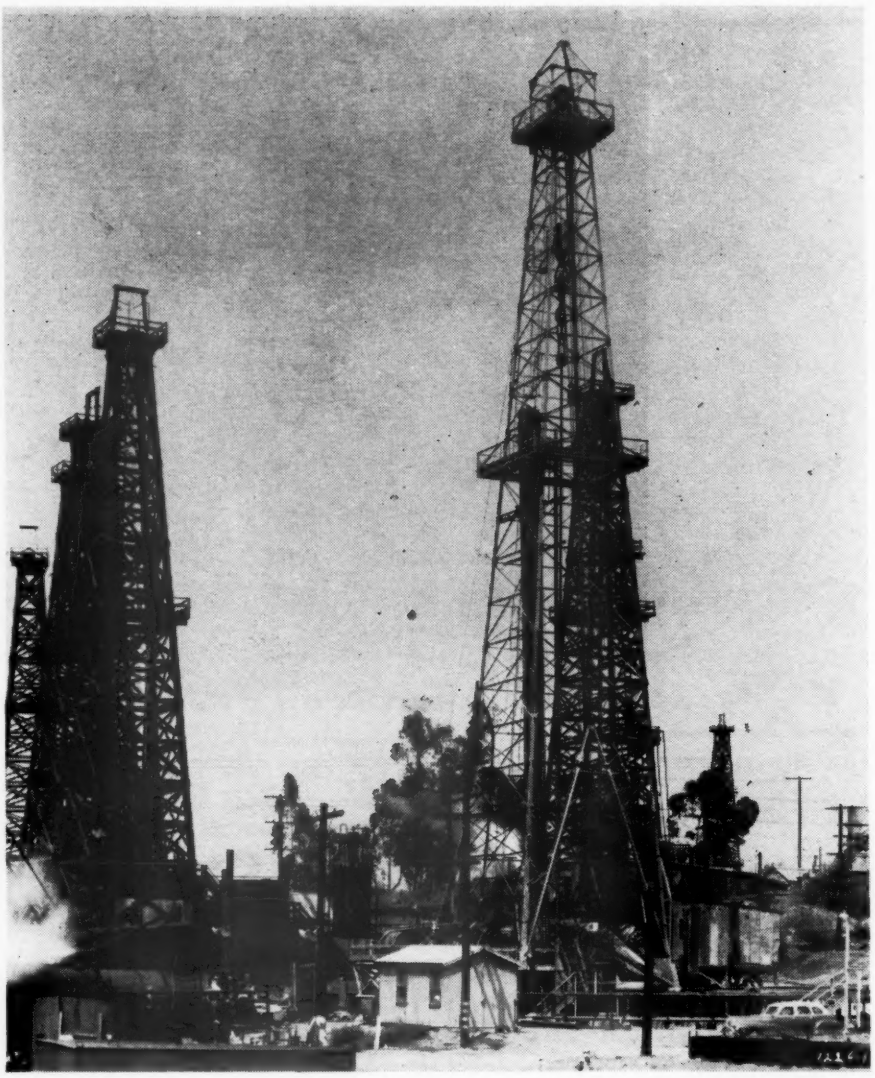
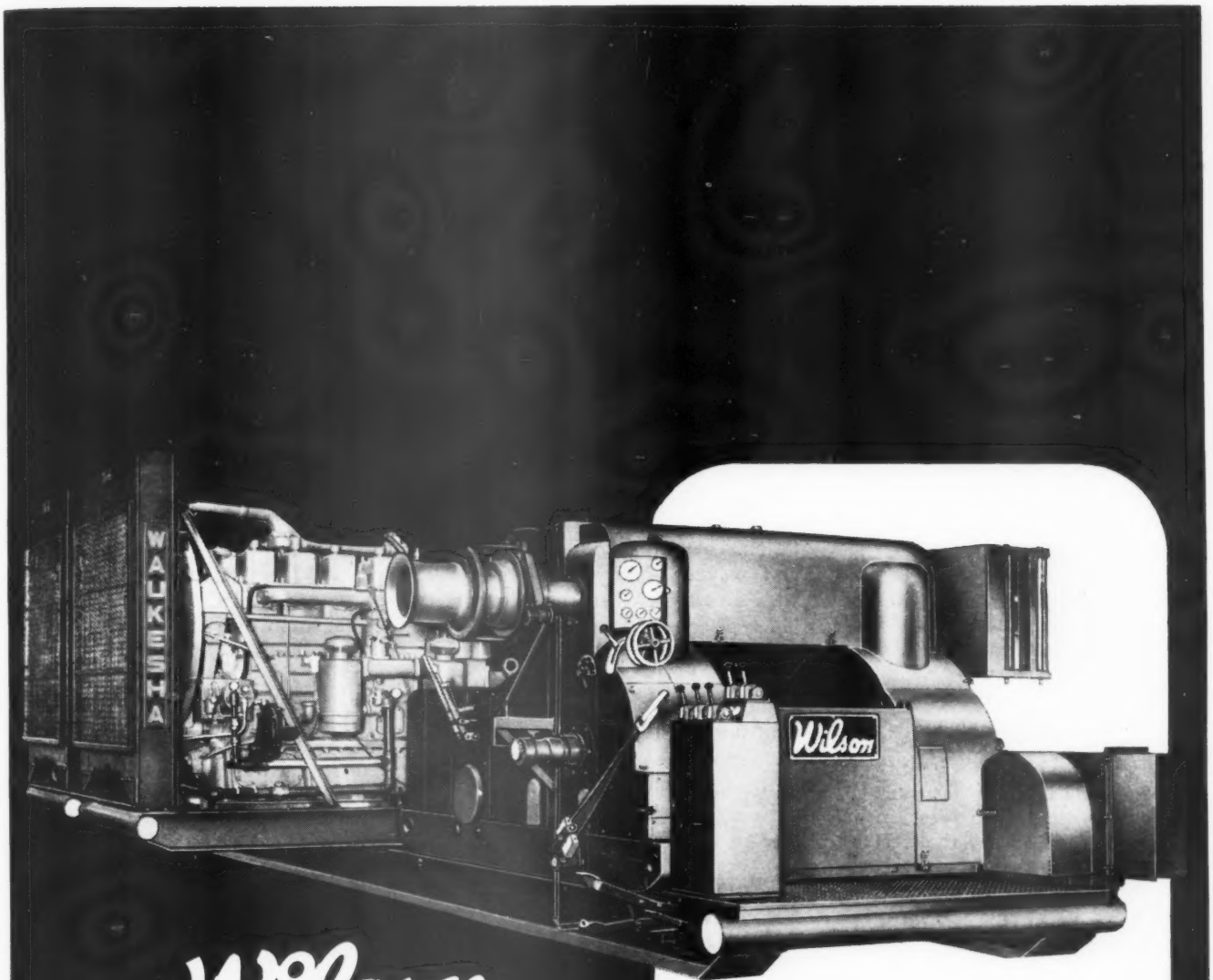


Victory No. 1, Rocky Jerman's third try for a big producer in the Signal Hill De Soto zone. This pioneer Long Beach operator believes that modern drilling methods improve the chances for a good well on the western flank of the formation

Jerman and his associates were sufficiently impressed that they immediately began drafting extensive plans for the further exploitation of the De Soto sand. Meantime. the Allied Petroleum Corporation drilled an offset well southwest of the Dormax. It was completed on June 1, 1940, at 10,640 ft for about 75 bbl a day of 28° API oil, cutting 5 per cent. While the Dormax well was drilling, Jack Rogers attempted to prove the extension of the deep zone westward, with a well at the corner of Spring Street and Long Beach Boulevard. Unfortunately, after drilling to 10,156 ft, the drill pipe twisted off and defied all efforts at recovery, so the well had to be abandoned. Union Oil Company's Long Beach Community No. 19, located at the southwest corner of 25th Street and Rose Avenue, across the street from the Dormax well, was completed on February 2nd, 1941, for 103 bbl a day. Several other deep wells have since been drilled, but none excepting those mentioned have really tapped the De Soto sand.

However, although operators in general have been discouraged by the low permeability of the tight producing sand in the De Soto zone, and the low yield in relation to the high cost of deep drilling, Rocky Jerman has never quite lost his belief that oil in copious quantity will yet be recovered from the De Soto sand. And this is no mere hunch! Rocky is an experienced and astute driller, who has had to learn his geology the hard way. He knows subsurface conditions in the area as well as most of the experts, and he is certainly well qualified by actual experience to debate the character and extent of the deep zone. Some of the leading California geologists have indicated that



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the existence of more permeable sands in this zone in other parts of the field is not at all unlikely. Rocky subscribes to that wholeheartedly, and he feels pretty sure that his test on the western flank will prove this contention. Besides possessing a genuine regard for the possibilities of the field, he is convinced that knowing a great deal more about drilling fundamentals and proper completion procedures than 10 years ago, a better all around job can be done.

The new Jerman well, Victory No. 1, is located at 31st and Elm Streets, to the west of the Dormax, and at the moment of writing is down to 8800 ft. The prospective completion depth is approximately 10,000 ft. Coring is being done in strategic intervals and it is expected that a formation test will be made, if nothing untoward happens in the meantime, in the latter part of October. Operators on the Hill are watching the progress of the well eagerly, and if it turns out to be a sizeable producer there is no doubt that it will promote an orgy of drilling, reminiscent of the halcyon days of 1921 and 1922. Even if it fails to produce in considerable quantity, it is questionable if Rocky Jerman will abandon his quest. The presence of a deep zone has been definitely established and it is certain that these pioneer operators will not rest content until they have developed positive information about the zone.

It will be recalled that when De Soto No. 1 was drilled in 1938, open-in some 400 ft of new formation, 260 ft of which was estimated to be oil sand, it was popularly predicted that should this ratio be maintained for another 400 ft—and many geologists believed that it would — the possibilities of the De Soto zone would be limitless. Then the Dormax came in a year later opening up twice the thickness of producing formation, and it seemed likely that the predictions would be fulfilled. But while the Dormax was a better producer than the discovery well, it still fell far short of expectation. They say the third try is lucky, and maybe Victory No. 1, drilled with a vastly greater know-how than its predecessors may be the one to break that deep sand jinx on the Hill. Whatever happens, Rocky Jerman is to be commended for his unshakeable faith in the ultimate success of the deep zone adventuring, and his untiring effort to assure that success.

Rocky was born into the oil business in Bradford, Pennsylvania, and was originally known as Roscoe William Jerman. His father was a well known "rope choker" of his day, and it was natural that the boy should soon follow in the parental footsteps. At 14 years of age he worked up in the San Joaquin Valley as a rousty, putting in foundations for oil derricks. After a spell of that he started roughnecking for the old Kern Trading and Oil Company. By 1920 he was drilling for McKeon Drilling Company on Section 10 at Taft, and has been active in the drilling business ever since. He came to the Los Angeles basin in 1922 with McKeon and drilled on the Oceanic No. 2—his first experience in the Long Beach field. It was at the corner of Anderson and Cherry. For a time he drilled for Cy Bell and Len Little at Naples, then transferred with Jack McKeon to Petroleum Securities Company. When the latter was taken over by Richfield Oil Company, Rocky became Richfield's first driller in the Basin. When Italo Petroleum was formed, he followed McKeon into that organization. That was about 1928, and when the crash came a year later, Italo all but succumbed—and so did Rocky. He drilled on one well for Jim Pollard later and then launched into the operating business on his own account.

He drilled the first well for himself at Lemon and 25th Streets in 1930, and has since become one of the busiest and best known operators on Signal Hill. In behalf of Signal Drilling Company, which he owned jointly with Ed Gieck, he brought in the first directionally drilled slant hole under the famous "million dollar cemetery" This was completed for approximately 726 bbl daily, and started a right profitable process that is still going on. He then took time out to drill three wells in Kern County, but immediately thereafter was back on his favorite hunting ground.

Rocky spent $220,000 and $171,000 respectively drilling the De Soto and Dormax wells. They have probably more than paid out in the years that have intervened—and they are still producing at commercially profitable rates, but the important point is that they have developed data which justifies, and guides, the present venture, with greater hopes of success. Some 800 ft of the De Soto zone have been opened to production. Reputable geologists believe the zone may eventually prove to be 3000 ft thick. Anyway, a lot of people are hoping that there may be something significant in the name of Rocky's third deep zone try, and that it may, indeed, turn out to be a Victory No. 1.

* * *

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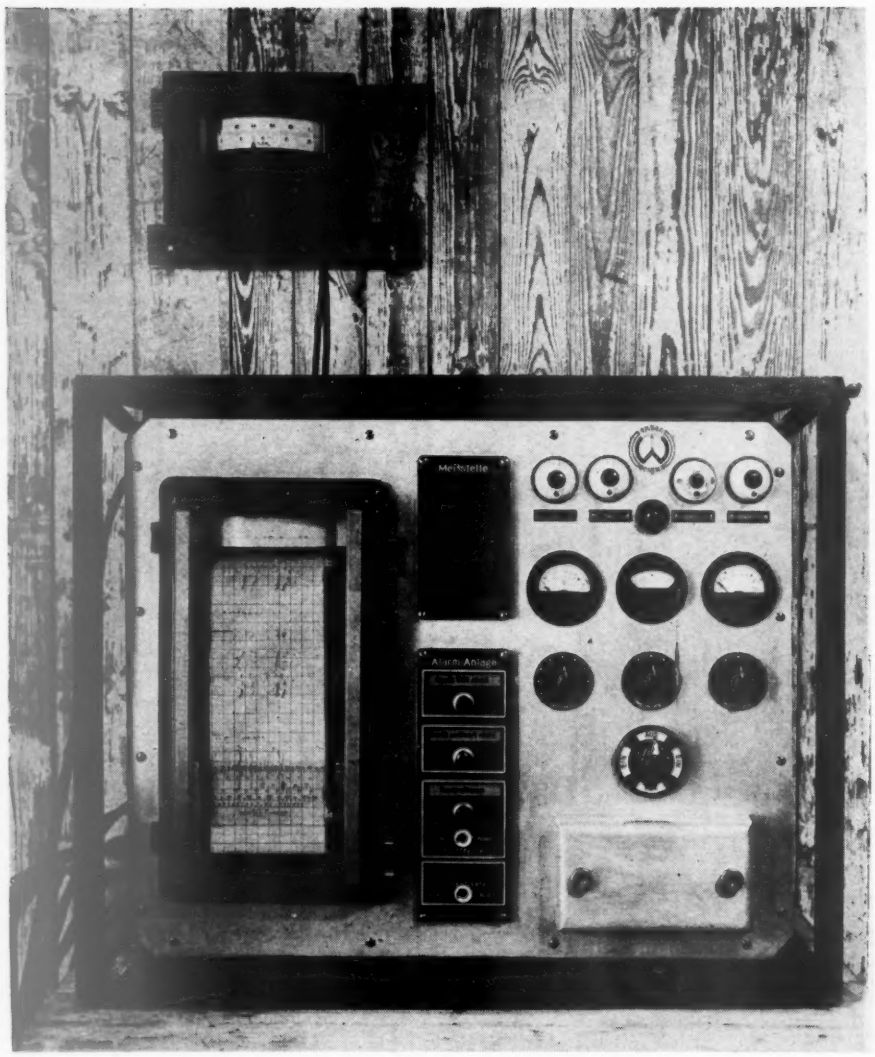


Switchboard with alarm device.

Recording Device for Control of Drilling Mud

By F. NEURATH, Chemical Engineer, London

EXCLUSIVE

THE mud recorder discussed herein is one approved by and constructed for the Soviet-controlled oil fields of Zistersdorf, Austria.* Its purpose is to test continuously the seven most important features of drilling mud and to record the figures by an electric color-print recorder. The curves so obtained give a picture of the drilling properties during the entire drilling period.

The most important measuring components of drilling mud are: Specific gravity, temperature, gas, "gel"-strength, pH-degree, viscosity, and sand content. Only the continuous recording of the measured figures, without any human influence, makes it possible to survey exactly and efficiently the properties of drilling mud.

The mud recorder is installed on the derrick. An alarm device warns optically and acoustically when the flow of drilling mud is interrupted and at the appearance of gas. A siren calls the drilling supervisor to the controlling unit to control the curves of the mud properties every hour during normal drilling and every 20 min during dangerous drilling.

The mud recorder consists of:

(A). A measuring unit (place of installation: derrick).

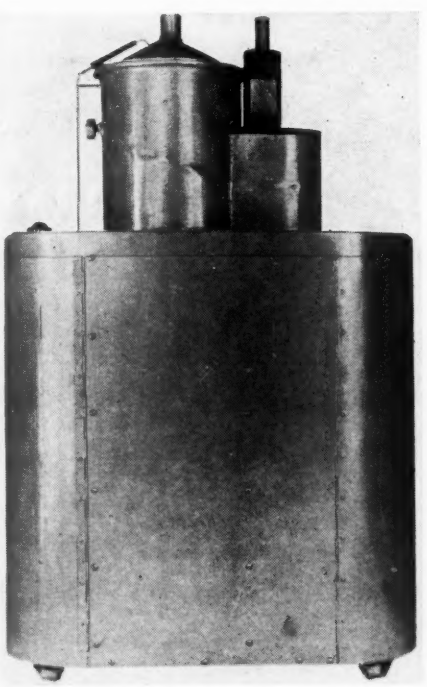
(B). A recording unit (place of installation: office of the drilling superintendent).

Both units are electrically connected by cables for the transmission of the impulse and measuring currents.

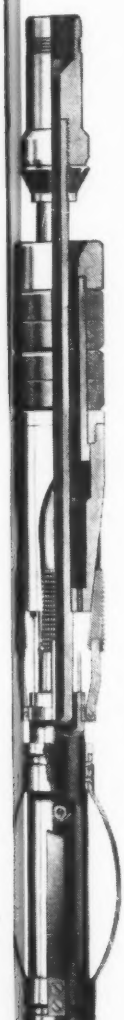
Measuring unit. The measuring unit is installed on the derrick and in direct connection with the mud discharge tube. A mud discharge device is mounted in the discharge tube and empties the drilling fluid into the measuring unit without admission of air. In the measuring unit are installed the sets of the seven measuring components as follows:

Measuring of specific gravity. Definition: The hydrostatic pressure of a liquid depends on the height and specific gravity of the column of liquid. If the pressure is measured at two different depths, the difference of pressure at constant heights gives a figure of specific gravity. The specific gravity is the weight of one liter of the drilling mud in kilograms. The scale shows kgs per liter. Range is 100 to 200.

Apparatus at the derrick.



*An invention of Ing. F. C. Windprechtinger of the Institute for Scientific and Technical Measuring, Vienna.



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BOC — a casing-to-tubing hook wall packer with circulating valve and bypass which allows easy running through fluid.

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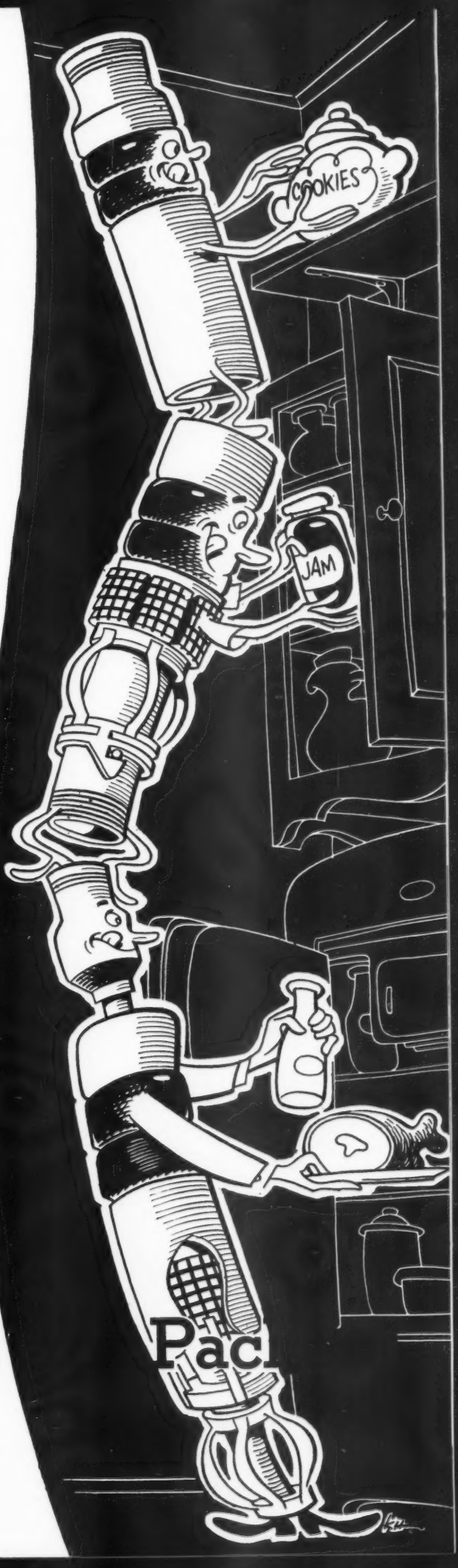

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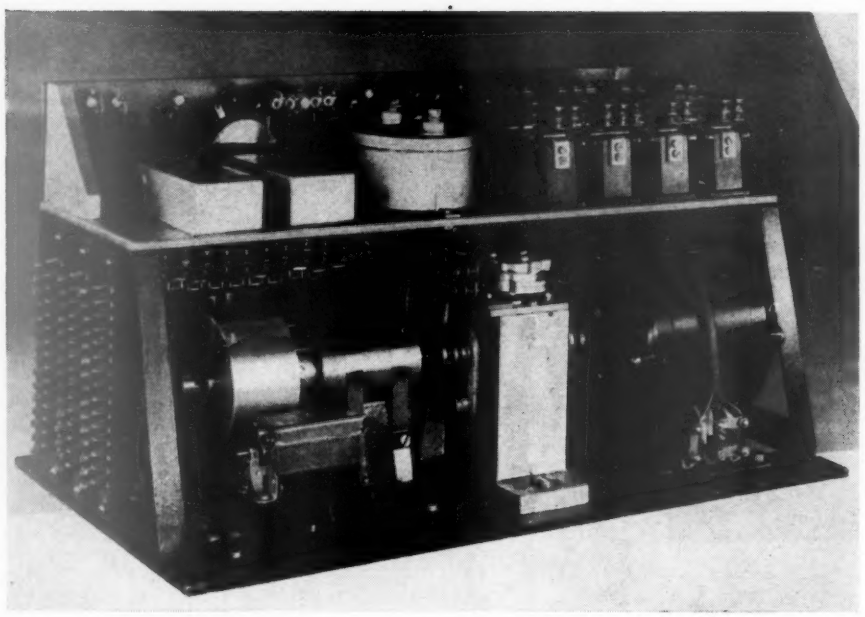
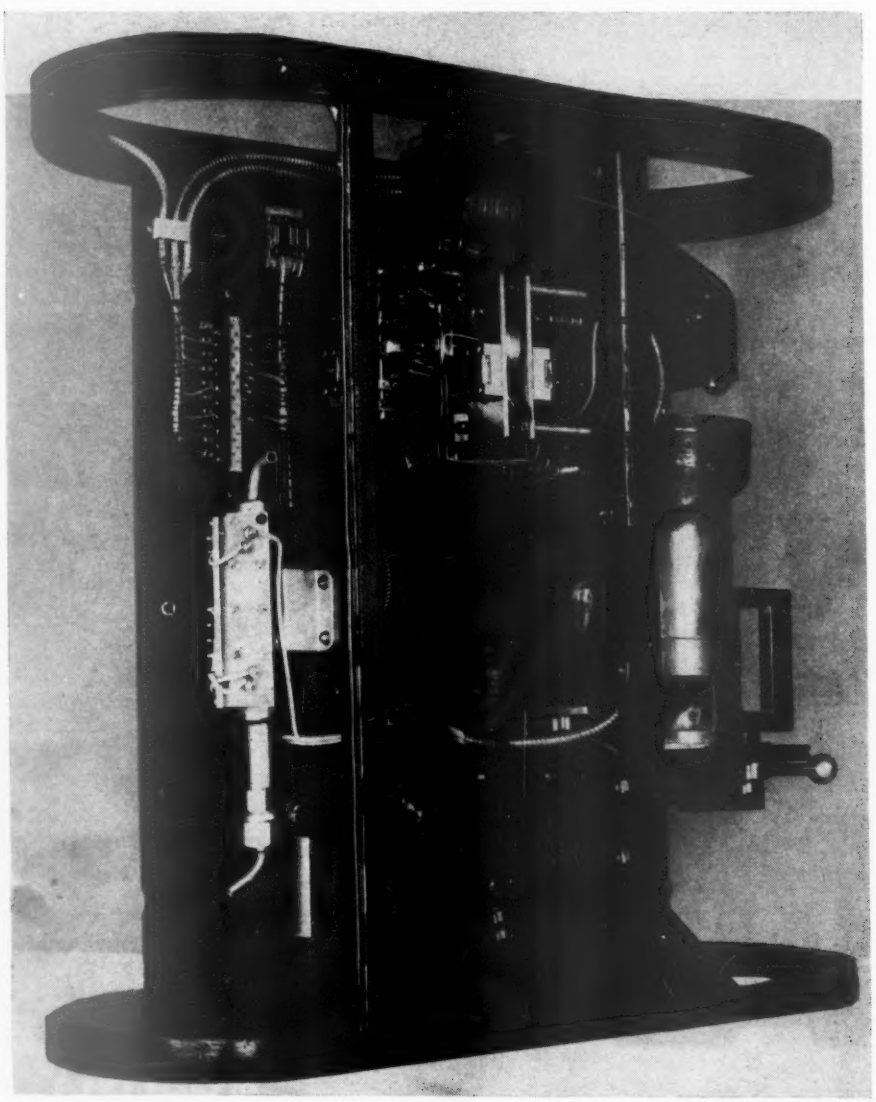


Motor, siren, and controls used in command apparatus.

View of instrument assembly inside the measuring apparatus.



Measuring of temperature. Definition: The resistance of an electric conductor depends on its temperature. Therefore from the measured resistance the temperature can be deducted. The scale shows the temperature in degrees of Fahrenheit. Range: 32-172 F.

Measuring of gas content. Definition: The caloric conductivity of any mixture of gas depends on its chemical composition. The gas content can be deducted from the caloric conductivity of air as base. The gas quantity lifted by the drilling fluid is marked in the scale in a percentage of a constant gas and air mixture. Range: 0-20 per cent.

Measuring of "gel"-rates. Definition: If there is an increase in the inner friction of a liquid, the change of viscosity during a given time gives the "gel"-rate. The scale division indicates the time of discharge of a liter of the drilling fluid after a rest of 3 min. Range: 10-25 sec.

Measuring of pH-degree. Definition: The chemical reaction (acid to alkaline) of a liquid depends on its content of hydrogen ions. The tension between two electrodes depends not only upon the material of the electrodes, but also upon the electrolyte. The concentration of hydrogen ions (pH-degree) can thus be determined. The scale indicates the hydrogen exponent, i.e. that figure, which taken as a negative exponent of 10, states the content of hydrogen ions in the drilling fluid in gram ions per liter .1 gram ion $= 6.06 \times 10$ hydrogen ions. The rate of acidity or alkalinity of the drilling mud is characterized by the hydrogen exponents. Range: pH-degree 0-14.

Measuring of the viscosity. Definition: The time of discharge of a liquid of a container depends upon the inner friction, i.e. the viscosity of the liquid. The viscosity may thus be determined by the discharge time from a certain container. The viscosity is based on the viscosity of water (viscosity of water $= 1$).

Measuring of the sand content. Definition: In a motionless drilling mud sand is settling according to its specific gravity. Range: 1-100 mm-scale on the centrifugal test tube.

▸ **Recording unit.** The recording unit can be connected to electric mains of all usable tensions (110-240 volts a.c., 50 cps). The seven different testing units are controlled by a selector switch driven by synchronous motor. The time required for completing the seven measurements is 7 min at a frequency of 50 cps. When the selector switch has been started a red signal lamp on the recording unit and another one on the measuring unit indicate that the entire mud recorder is

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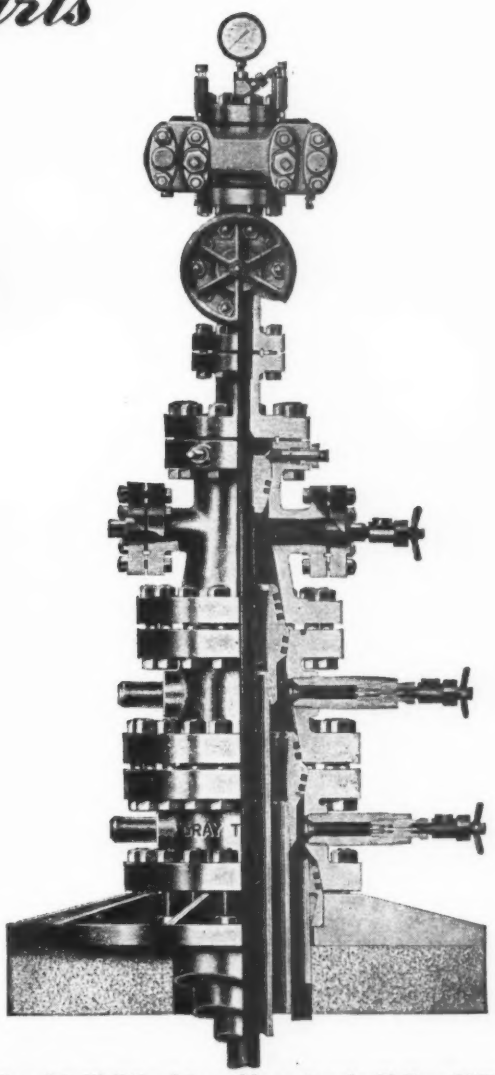

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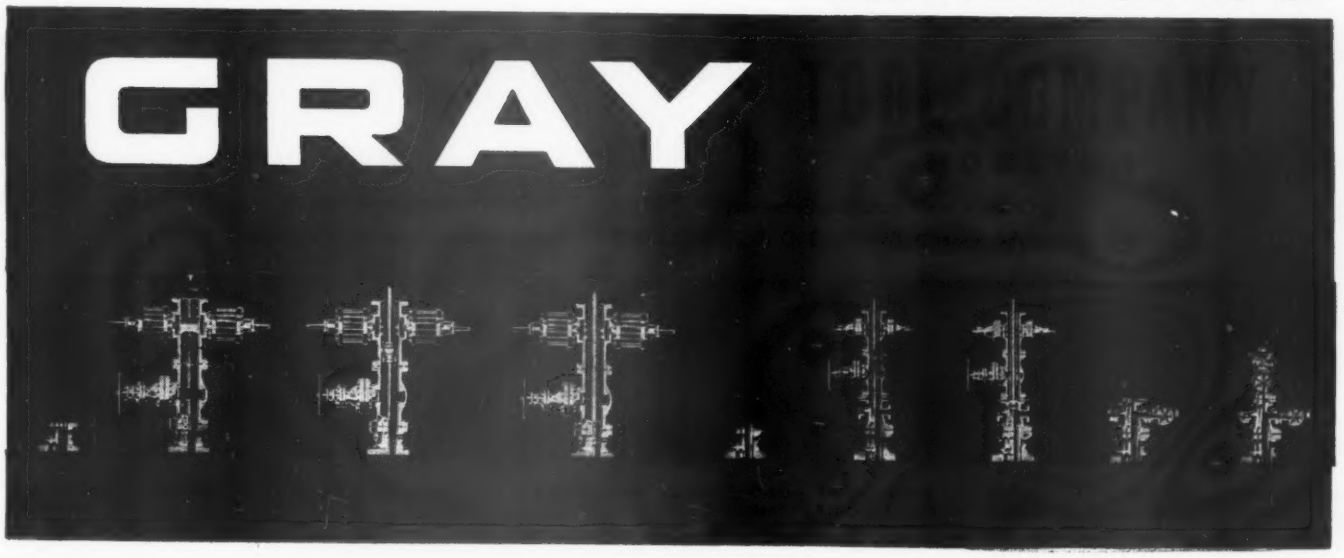

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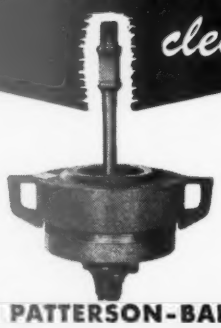

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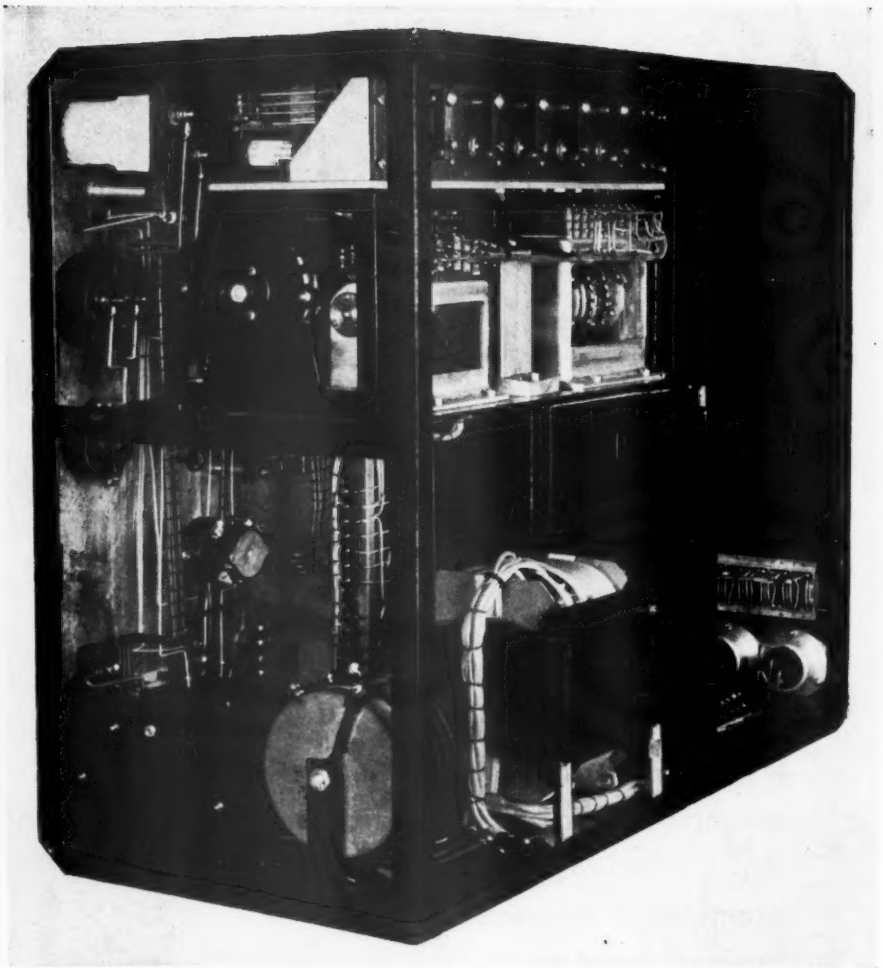

Inside of switch apparatus showing how instruments are mounted.

working. The main voltage is indicated by a voltmeter and can be regulated in case of voltage drop by means of a special instrument. The measuring currents are controlled by two ammeters and can be regulated by means of two potentiometers. Four automatic fuses are mounted on the front panel. The lamp indicator for the measuring positions is subdivided in seven light sections. The lighted section is the one just in action.

The measuring components are marked in seven different colors. Specific weight—violet; temperature—grey; gas—red; "gel"-rate—brown; pH-degree—blue; viscosity—green; sand content—white = black.

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"No-filling" indicated by lighting up of a pilot lamp on the alarm indicator and continuous sounding of an electric horn installed in the derrick.

"No discharge." The same signal as above. Both signals can be stopped by a push-button.

"Control," indicated by lighting up of a pilot lamp on the alarm indicator and sounding of an electric horn at short intervals. The control call, adjustable by a switch, is effected at intervals of 60 min at normal drilling or 20 min during dangerous drilling periods.

"Gas." Occurrence is indicated by lighting up of a red flash signal and starting of a siren (howling sound). The gas alarm siren can be stopped by a switch, but stopping of the flash light is impossible as long as gas is recorded at a certain percentage. The gas regulator is adjustable from 0-20 per cent in steps of 1 per cent. The optical and acoustical signal "Gas" is released as soon as the indicated gas valve is reached. All measurements are recorded epidiascopically by an electric color point recorder on a measuring tape in the same colors as on the measuring lamp indicator. A transparent scale carrier is mounted in front of the recorder glass and is marked with the average and optimum figures admissible for each particular measuring component. A second scale carrier is used for the practical calculation of the diagrams. The recording unit is suspended elastically and free of vibrations in a steel frame. * * *

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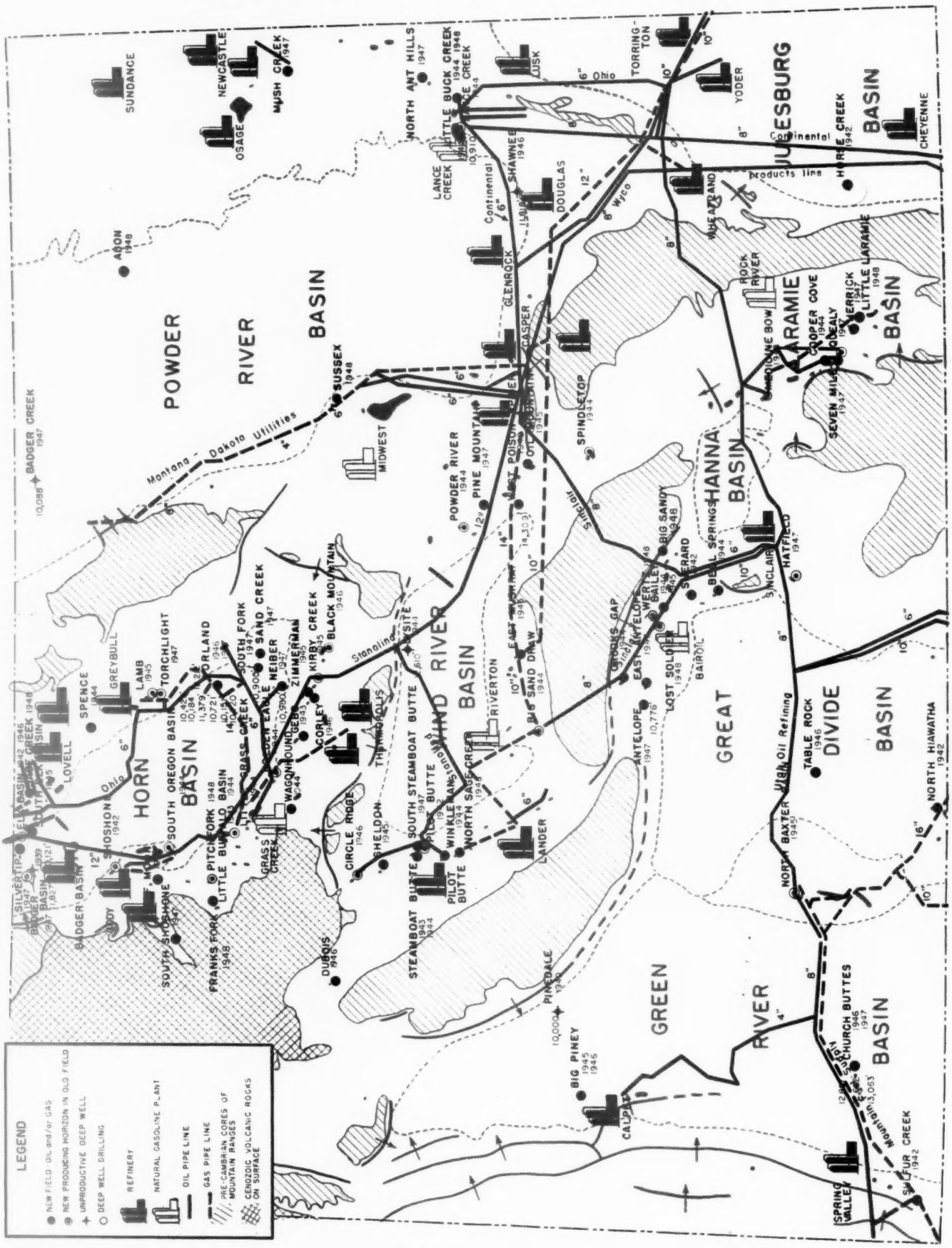
PETROLEUM MAP OF WYOMING



Established oil and gas fields of Wyoming, pre-Cambrian and Cenozoic rocks, and major faults are illustrated by the lavender background on the map. Oil and gas field activity between 1942 and June, 1948, and wells drilled below 10,000 ft are shown in black. Pipe lines, refineries, and natural gasoline plants are given in red.

Black and lavender sheets from H. D. Thomas, "Geology and Petroleum Resources of Wyoming," page 128.

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Application of Secondary Recovery in the United States as Related to Emergency Oil Requirements*

By PAUL D. TORREY†

● **Abstract:** The shortage of liquid fuels that developed in recent months focuses attention on the ability of the petroleum industry to supply the future domestic demand for oil in the United States, and more particularly the emergency demand for oil that would be required for the defense of the nation in the event of war. The shortage of oil is being used as an excuse for greater federal control of the industry. If the industry can demonstrate positively its ability to supply both ordinary and emergency demands, much of the argument for federal control will be eliminated.

The amount of oil required to meet the estimated ordinary and emergency requirements of the nation could not be produced continuously without serious damage to the ultimate recovery of presently known primary reserves. Competent authorities have presented evidence that the immediate future ordinary demand for oil can be met, but there is certainly serious question whether existing primary reserves are adequate to supply a prolonged emergency demand.

Since the development of new production from prospects in the tidelands is being retarded by federal action, the most promising approach to the problem of supplying oil for national defense may be found in the more general application of methods for increasing the recovery of oil from known reserves. The reserves of oil that will not be recovered by present production methods are tremendous. As an example, the oil that will remain in permeable Permian reservoirs of West Texas alone, and which should be susceptible to improved recovery technology, is abundantly sufficient to supply the maximum estimated demand for national defense for a period of about six years, if it could be made available at the desired rate.

There is undoubtedly some point where secondary recovery operations in deep fields and in thin reservoirs will not be profitable because of competition from synthetic and substitute fuels. Production of liquid fuels from natural gas is already an accomplished reality, but so long as the industry can expand production to conform to demand and can utilize gas for which there is no direct or profitable market, such operations should not retard the development of a large majority of presently known secondary prospects. Competition from synthetic fuels produced from coal and from oil manufactured from shale is more remote, and has little bearing on the profitable application of secondary methods in most fields where promising additional recovery possibilities exist.

The application of pressure maintenance to recently discovered oil reservoirs, where efficient, unaided primary recovery cannot be expected, is even more important than obvious applications of secondary methods in older fields. In many cases, however, neither pressure maintenance nor secondary recovery operations are feasible unless it is possible to unitize the field, and this cannot be done so long as laws are inadequate or lacking.

Wells will be an essential part of most secondary operations, consequently, no oil well should ever be abandoned without giving consideration to the effect such action will have on future possibilities for increasing recovery. With vast sums being spent each year in an effort to augment existing oil reserves, the promising prospects for obtaining more oil from presently known fields are deserving of careful attention. Work now in progress by the American Petroleum Institute will help to evaluate better these prospects.

● **Introduction.** Only a few months have elapsed since the petroleum industry of the United States, for the first time in its history, has been confronted by the dilemma of being unable to meet the demand for its products. A multitude of reasons has been advanced for the shortage. Most industry representatives, although admitting the existence of a scarcity of refined products, have testified that shortages are temporary, are susceptible to correction, and are not due, necessarily, to any overall dearth of oil in the United States.

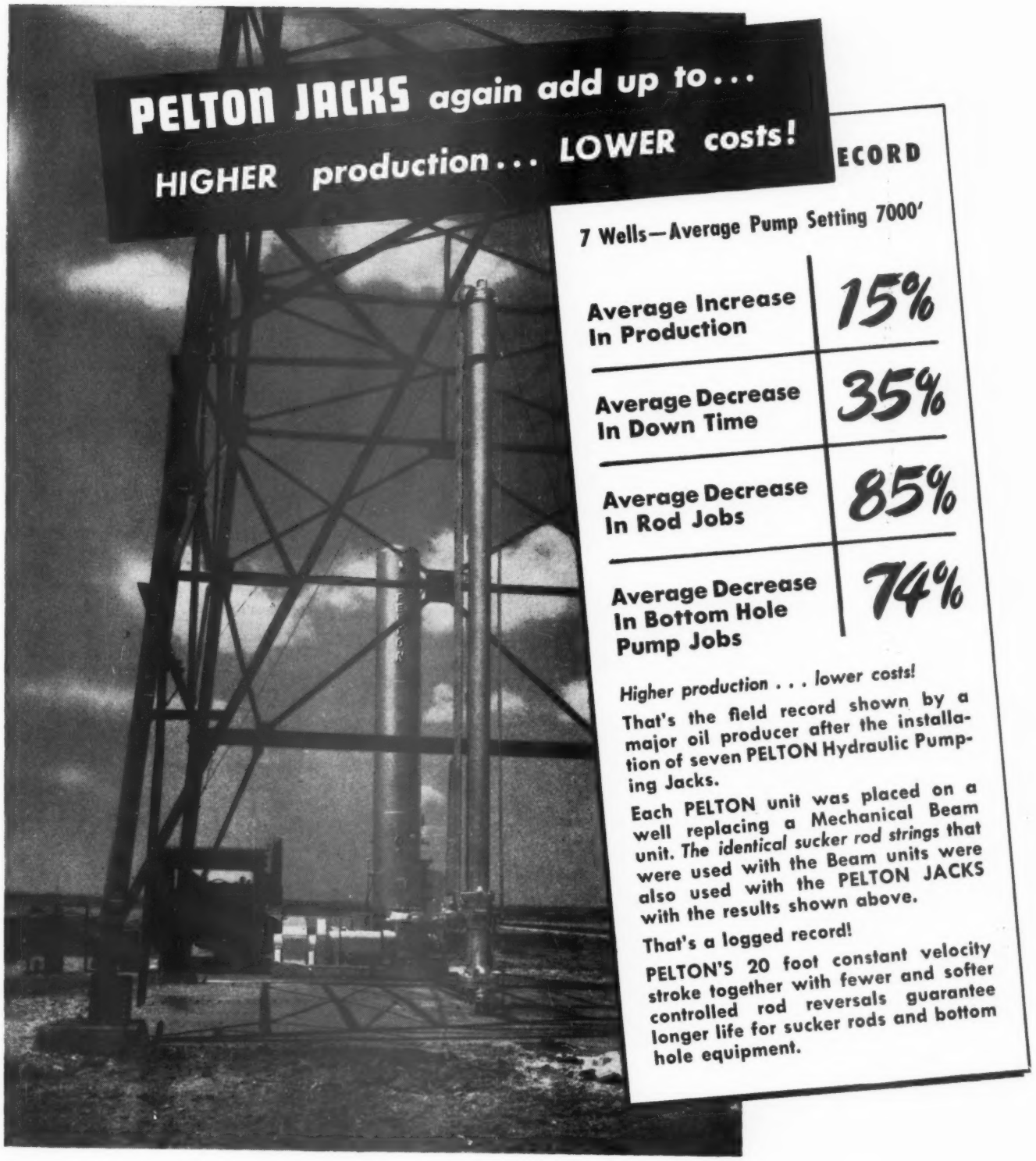
Among the causes that have been cited for the shortage of oil are: Limitations in transportation facilities, and a substantial deficiency that has been needed so badly for drilling and production equipment, for new pipe lines and tank cars, and for new refinery construction. Even with these deficiencies, the supply situation might not have become so aggravated had not abnormally severe weather accentuated the demand, and at the same time affected seriously the retail delivery of liquid fuels. No one can deny that there have been very definite changes in the fuel consuming habits of the American people, and it has been apparent for quite a few years that as long as oil and gas remain plentiful and cheap, they have no difficulty in replacing coal. Low price as well as great convenience has converted a large section of our population to the use of oil, and, as a result, in 1947 the energy requirements supplied by petroleum and its products for the first time in history exceeded those obtained from coal.

It is not the purpose of this paper to consider problems of supply and demand, except as they may bear directly on the application of secondary methods. It does seem appropriate, however, to remark that the conclusions reached by the API Committee of Eleven[1] in September, 1925, are just as pertinent today as they were more than 20 years ago, and that they have direct bearing on many phases of efficient oil recovery technology. This committee, in considering measures for insuring a supply of oil sufficient for the needs of the nation, recommended that the right to own and lease oil lands be made secure; and that those engaged in the industry be permitted to exercise initiative, have liberty of action, enjoy free competition, and receive prices for petroleum and its products commensurate with the risks involved and the capital invested. The necessity for preserving the rights and conditions, which the Committee of Eleven stated were essential for the maintenance of adequate crude production, becomes impressively apparent when it is recognized that certain officials of the federal government have been utilizing the acute supply situation as an argument to obtain controls over the industry and the price of its products, and to justify the expenditure of vast sums in the development of a synthetic fuel industry. Consequently, anything that can be done through the industry's own initiative to demonstrate ability to supply oil when and in the amount it may be needed, both for ordinary and for emergency needs, will help to erect a formidable defense against what seems to be ever-present danger of encroaching federal authority.

The results obtained from the application of secondary methods[(a)] in various parts of the country can be utilized impressively in arguments against federal control for unique reasons. These methods have been developed by and for the industry, and their application can always be cited as direct recognition of the responsibility to assure the maximum economic recovery of oil. Efficient primary oil recovery many times is taken for granted, and is regarded merely as an example of good business, whereas the oil produced by secondary methods

*Presented before Pacific Coast District, Division of Production, American Petroleum Institute, Los Angeles, California, May 6-7, 1948.

†Consulting engineer, Houston, Texas. Chairman, Standing Subcommittee on Secondary Recovery Methods, American Petroleum Institute; Chairman, Advisory Committee on Secondary Recovery, The Interstate Oil Compact Commission.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carries with it the special significance of salvaging a valuable resource that otherwise might be irretrievably lost.

● **An ever-increasing demand for oil.** In most of the recent discussion, there seems to be general agreement that nothing less than a national calamity will serve to diminish the current and future demand for petroleum and its products. The Economics Advisory Committee of the Interstate Oil Compact Commission,[2] a recognized authority on the subject, has predicted that the 1948 demand for petroleum in the United States will amount to about 6.2 million bbl per day. This represents an increase of nearly 6 per cent over 1947, and an increase of almost 35 per cent during the last five years. If the possible emergency requirements for oil, recently estimated by the secretary of defense, are taken into consideration, the conceivable demand in this country in the event of war might exceed 8 million bbl per day. Obviously, oil in this amount could not be produced continuously without serious damage to the ultimate recovery from the nation's present primary reserves. Therefore, even though it might be possible to make temporary increase in production, an emergency, which might eliminate foreign imports, would necessitate drastic restrictions in civilian consumption to insure requirements for national defense. When consideration is given to figures of such imposing proportions, and to the troubled conditions in the Near East that might eliminate an important world source of crude supply, it can then be understood why attention is being given to the possibilities for production of synthetic fuels from natural gas and coal, and to manufacture of oil from shale.

● **Ability of industry to meet demand.** How far this country may go in the future in the development of auxiliary supplies of liquid fuels will depend on several factors, some of which have already been mentioned. If, for instance, we could be assured of a continuity of foreign imports to supplement domestic production, and of prices that will reflect the true value of crude petroleum and its refined products, the future liquid fuel requirements of the United States could be viewed with considerable equanimity. Also, as an alternate, if security from dependence on foreign imports of oil can be established by the discovery of large new reserves in the continental United States or in the tidelands, or if increased recovery from existing reserves can be assured, the immediate justification for large competitive expenditures by the government will be removed. The Economics Advisory Committee of the Compact[2] has stated emphatically that the immediate future ordinary demand for petroleum can be met provided no disturbing conditions arise. This well-informed committee, in considering the effort that has been made to supply liquid fuels, commends the petroleum industry for the amazing success it has achieved under the very difficult conditions that have prevailed.

The Independent Petroleum Association of America,[3] in its comprehensive and thorough analysis of the problem of required material supply for the oil industry, offers a possible solution to the problem of showing that a direct relationship exists between drilling activity and the maintenance of our reserve position. If past experience can be accepted as a reliable criterion, this study should serve to assure the nation that its peacetime requirements for oil can be met if resources and supplies to enable the drilling of many wells are made available. The promising trend in discoveries in 1947, when additions of some 3.26 billion bbl were made to the primary reserves, encourges the thought, for the time being at least, that such an assumption is probably valid. It might continue to be so if presently known exploration techniques can provide new oil fields at the rate of former discoveries. However, the record of the past decade creates some apprehension that this may not be done, and that it might not be possible to provide from primary reserves alone all the additional oil that might be needed desperately in a time of emergency. It would be imprudent to disregard the well-established fact that the net reserves discovered by each successful wildcat well have declined steadily in recent years, thus indicating rather conclusively that the industry is finding it more and more difficult, and certainly more and more costly, to discover fields of major importance.

A factor that complicates all thinking on the future oil production ability of the United States and its relation to possible emergency needs, is the question of the little proved but presumed large reserves that exist in the tidelands. The orderly exploration and development of these offshore prospects are being retarded by the attempt of the federal government to obtain control of them. Until the congress can establish the rights of the several states, the uncertainty of the situation makes difficult the proper evaluation of what may prove to be the easiest opportunity for reversing the recent discovery trend.

● **Increasing recovery from proved reserves.** No one can question the necessity for giving preferential attention to that oil which may be required for national defense. Consequently, since the prospects of the tidelands cannot be determined immediately, it is believed that a most promising approach to the problem of assuring emergency oil requirements may be found in the definite possibility of increasing recovery from presently defined reserves.

Recently, in a very thought-provoking paper by Minckler,[4] it has been emphasized that California, which has been an oil exporting state for many years, may not be able to supply the forecasted demand for the Pacific Coast states in a period of a few years unless large new discoveries are made or unless drastic measures are taken to increase recovery from known reserves. The convincing arguments advanced by Minckler could be incorporated directly into this discussion, and would cause no alteration in the conclusions. Actually, a couple of states already have reached the point where primary production has not been sufficient to meet the demand, and others are rapidly approaching the predicament which may soon confront the California oil industry.

Fortunately, techniques for increasing oil recovery from many of the older fields have been in process of development over a period of almost 30 years. It should be possible to utilize these methods to great advantage and to benefit from the experience that has been gained previously. Pennsylvania, for instance, has developed successfully methods that have served to prolong the life of its oil industry. Subsequently, this demonstrated ability to increase the recovery of oil has found wide application in other regions that have been confronted by diminishing production and negligible new discoveries. Such being the case, the overall picture does not appear too discouraging, and, in fact, in the light of past experience, the maintenance for many years of profitable production in most of the oil states can be regarded as possessing very promising possibilities.

● **Magnitude of unrecovered reserves.** The magnitude of the unrecovered oil in the United States has never received the attention that it deserves. Investigations in progress by the American Petroleum Institute and by the Interstate Oil Compact Commission should supply in the near future more authentic information than can now be presented. There is no question but that the amount of oil that will remain in many reservoirs by present recovery practice is tremendous.

Recently, a preliminary study by the writer indicated that the original oil content of the Permian reservoirs of West Texas amounted to some 26.23 billion bbl of oil, an amount substantially greater than the accepted primary recoverable reserve of the United States. This study revealed that 11.70 billion bbl of this oil occurs in rocks, which will contribute little or nothing to primary recovery, leaving some 14.53 billion bbl in permeable reservoirs from which an ultimate primary recovery of 4.79 billion bbl of oil is expected. With an indicated average recovery efficiency of 32.9 per cent, there will be left in the more permeable strata of these great reservoirs the very considerable quantity of some 9.74 billion bbl of oil.

The immensity and importance of these accumulations will be more evident when it is appreciated that the combined original oil content of five prominent Permian reservoirs: Wasson, Fullerton, Slaughter, North Cowden, and Yates was slight more than 11 billion bbl. This amount approaches the total primary reserves of Texas.

Unfortunately, it cannot be estimated positively and for every field the part of this anticipated residual oil that can be recovered by the application of secondary methods, or, preferably in the

(a) See references.

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younger fields, by proper control or primary reservoir energy. Some of the West Texas fields, where reservoir energy has been conserved, will have superior primary recovery. However, in general the abundance of oil that has been available for more than 20 years, combined with low prices, low production allowables, and the inability to unitize the University and Public School lands, have not encouraged the application of improved recovery methods in most of the older fields. The few gas injection and water flooding operations that have been attempted in West Texas for the most part have been poorly conceived, inadequately developed, and inefficiently operated. Frequently, secondary recovery has been employed merely as an excuse to preserve deep rights on leases that otherwise would be lost by expiration. Nevertheless, favorable reaction in a few instances to the injection of gas or water has been proved, and, if methods developed in the Eastern States can be applied successfully, or, if other techniques adapted to the peculiar conditions of irregular permeability that characterize the limestone and dolomite reservoirs can be discovered, it is indicated that the total primary recovery from many solution gas drive fields might be doubled by the proper application of secondary methods or pressure maintenance, depending on the age of the field. In such case, additional oil that might be produced in West Texas, could be sufficient to provide the estimated emergency requirements for the defense of the nation of 2 million bbl per day for a period of almost six years, if it could be made available at the desired rate.

It is hoped that the foregoing figures will not be accepted too literally, for in some respects they are not complete. They have been cited for the principal purpose of illustrating the added recovery possibilities of only a part of one very important petroliferous province of the United States. It is more important to remember that this great West Texas oil reservoir, and the reserves remaining in other like areas of the United States, do not require discovery. The oil has not migrated appreciably since it was first found, and the areal extent and magnitude of the reservoirs have been defined in most instances. Many of the fields are in advanced stages of development, so all additional recovery that can be obtained will serve to enhance the return on investments that have already been made.

Since West Texas is only one of the many important oil producing areas of the United States, the conclusion cannot be escaped that this country is abundantly supplied with oil and that much of this oil will not be recovered by the production methods now in use. It should be recognized, however, that effective oil recovery techniques, just like the conservation of soil and forest resources, have not always been known, and their development has taken place over a period of quite a few years. Likewise, for many years the price received for crude oil has been in no way commensurate with the value of the product, and has not permitted, in many instances, a normal replacement of produced reserves. As a consequence, in some important areas, such as West Texas, it has not been profitable in the past to apply methods for increasing oil recovery.

● **Some economic considerations.** W. B. Berwald,[5] in a paper presented at the 27th Annual Meeting of the American Petroleum Institute, has discussed adequately many of the factors that control the profitable operation of secondary recovery activity in the past and at present, such as property valuation, development and operating expense, quality and desirability of crude, and the profit that may be anticipated, will continue to govern the economic success or failure of future secondary recovery operations. As indicated by Berwald, all secondary recovery activity will be limited by changes in price structure that might accompany the discovery of large new primary reserves in the United States, or in the adjacent continental shelf. Also, there is undoubtedly some point in the future where secondary recovery operations in deep fields and in thin reservoirs cannot be profitable because of competition from synthetic and substitute fuels.

● **Synthetic and substitute fuels.** Interest on the part of the industry in the production of synthetic fuels may not be based, necessarily, on fears of an impending oil famine. Rather, it would seem that the trend of much of the recent research and planning has been directed to the conservation of gas for which direct and profitable markets may not be available. The commercial production of liquid fuels from natural gas under the conditions indicated definitely offers the best immediate opportunities, and should be recognized as such. It cannot be conceived, however, that such operations will be competitive for some time to come with much of the increased oil that may be obtained from presently known secondary recovery prospects unless they receive heavy subsidy from the government.

Extensive competition by liquid fuels produced from coal with secondary oil does not appear likely in the immediate future. The convincing evidence on this subject presented recently by Bruce K. Brown[6] before the Short Subcommittee of the House of Representatives, is worthy of consideration. It was emphasized by Dr. Brown, in his conclusions, that the liquid conversion program proposed by the government would require an increase of at least 60 per cent in the total production of coal and the number of miners in the United States. He also estimated that the energy value of the synthetic fuel would be about one-third of that of the coal put into the process.

In other recent testimony before congressional committees, there has been rather general commendation of research both by the government and by industry on methods that will serve to guarantee a domestic fuel supply adequate for all eventualities. Most authorities have concluded, however, that it is uneconomic to produce synthetic gas or coal for purposes that can be served more efficiently by burning gas or coal directly. Also, a continuation of expansion by industry in the production of synthetic fuels, as rapidly as economic conditions may require, has been favored, but there is general agreement that the steel and other equipment required to embark on an extensive program of synthetic fuel production could be used much more effectively at the present time in an expansion of crude oil production operations.

Similar conclusions may be advanced for possible competition between oil manufactured from shale and much of the oil that may be produced by secondary methods. The estimated reserves of shale in this country are large, being in the range of some 92 billion bbl. In his recent report to congress, the secretary of the interior has admitted some of the obvious difficulties connected with the manufacture of shale oil. Evidence developed at the experimental plant at Rifle, Colorado, indicates that under favorable conditions and large scale operations, oil from shale can now be produced at an estimated cost of from $2.00 to $2.50 per bbl. The products from shale oil are inferior to those obtained from most crude petroleum, however, and it is difficult to refine. These factors, when combined with the isolated location of the most productive deposits, support the conclusion that it will probably be a long time before dependence will be placed on shale as a major source of liquid fuels.

Obviously, as the available supply of crude oil and natural gas declines, more and more attention will be given to substitutes. The best available information, however, suggests that for several years to come it will probably be more profitable and more in the interest of national defense to devote principal attention to problems connected with the maximum economic extraction of oil from proved underground reservoirs.

● **Utilization of existing reserves.** The existence of large unrecovered oil reserves has no more significance than the existence of large reserves of oil shale unless methods are available to permit profitable production. Secondary methods now constitute the principal source of oil supply in New York and Pennsylvania, where they have been applied with great success because it has been profitable to do so. These methods are becoming increasingly important elsewhere. As the writer has emphasized repeatedly, however, the need for secondary methods is an open admission of past inefficient primary recovery. With the information that is now available on mechanics of oil reservoir performance, the industry is inviting trouble when wastful dissipation of reservoir energy is permitted in any field. No reasonable argument can be advanced against a plan that every new solution gas-drive oil field, which has reserves

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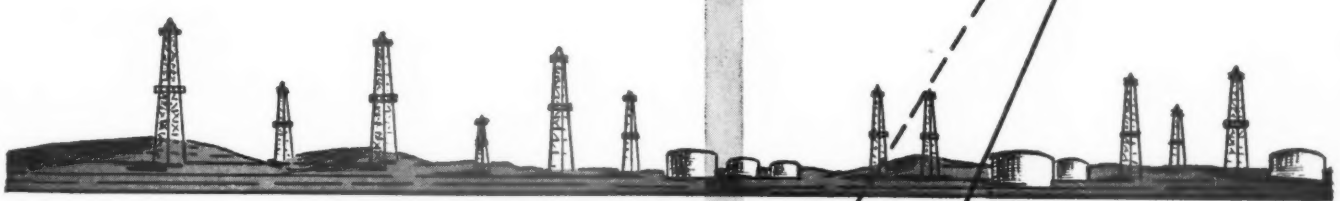

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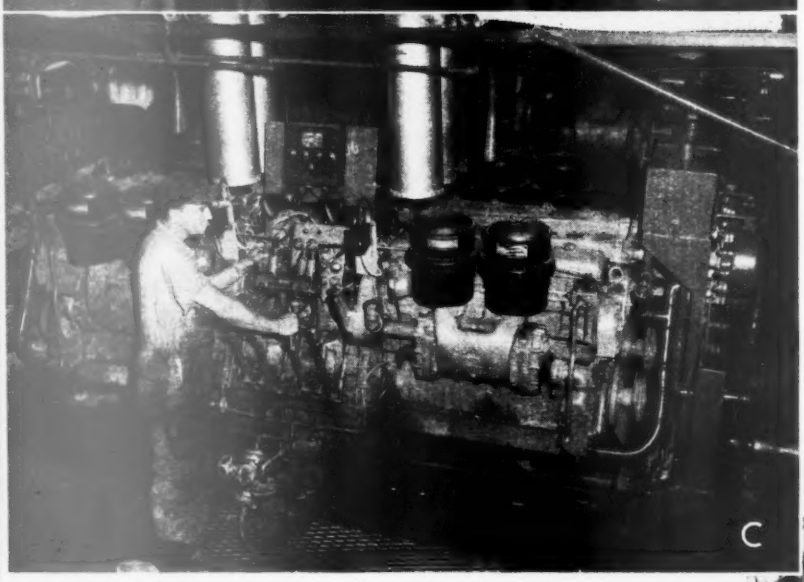

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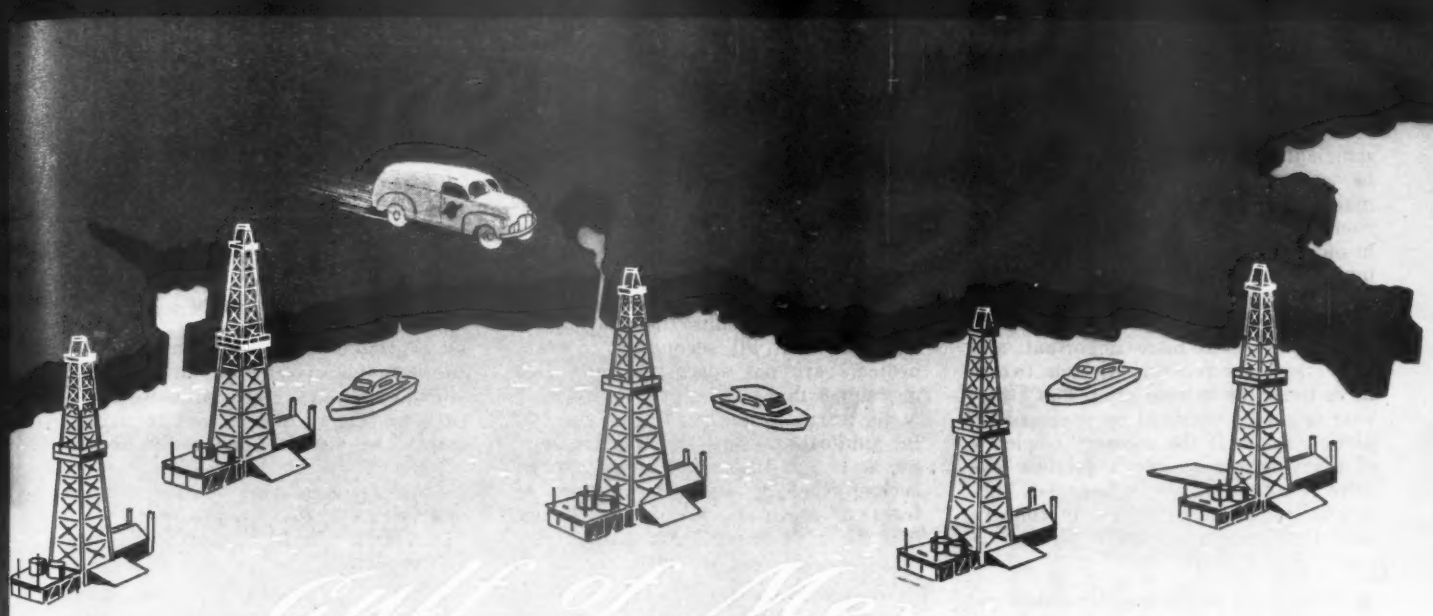

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sufficient to justify development, should be operated with adequate pressure maintenance. Thus, in addition to obvious applications of secondary methods in older fields, where much of the original reservoir energy may be exhausted, the general adoption of some form of pressure maintenance for the conditions indicated is even more important, and may insure the recovery of from two to three times the volume of oil that otherwise might be obtained by pressure depletion alone. If the recovery efficiency of many of the country's solution gas drive reservoirs could be improved substantially, much of the present concern over the immediate future oil supply could be dismissed.

● **Maximum utilization dependent on enactment of proper laws.** In order to apply secondary recovery or pressure maintenance effectively and economically, the unitization or cooperative development and operation of oil fields is usually necessary. This objective cannot be attained so long as state laws permitting the unitization of oil and gas fields are either inadequate or lacking, and so long as operators are liable for violations of antitrust laws if they join in a unit or a cooperative project.

This matter is of such importance that the writer[7] stated in his report to the executive committee of the Interstate Oil Commission, at the winter meeting in Oklahoma City, December 6, 1947, as follows:

"After careful consideration of the laws of the various states dealing with secondary recovery and unitization, the Advisory Committee on Secondary Recovery respectfully recommends that the Interstate Oil Compact Commission urge the authorities of every oil-producing state to give thought and consideration to the existing laws which may affect cooperative, pooling, or unitization agreements. The Compact should urge the enactment of new laws or the clarification of old laws whenever the same may be needed to authorize such agreements."

Nothing can be gained by advocating the application of methods for increasing oil recovery so long as they may place the operator in legal jeopardy, and it is certainly desirable that the various oil-producing states should be acquainted with this fact. Opposition to laws permitting unit operations is based usually on either ignorance or avarice, for so far as the writer can determine there are no unsuccessful unitization agreements where commercial oil production has been developed. Such being the case, the facts concerning the general success of unitized operations should receive wide publicity so that objections to unitization resulting from ignorance may be eliminated. Likewise, it seems clear that the oil industry and the states must cooperate to remove the nullifying effects that may be imposed by a selfish minority, who will purposely obstruct a program of unquestioned conservation designed for the common good of a field solely for the nuisance value it can create.

● **Prospects for increasing recovery.** An account of results that have been obtained from secondary recovery operations in various parts of the United States would involve a repetition that is considered needless. It should be emphasized, however, that there is great diversity in the results that have been obtained, that all secondary recovery projects are not successful, and that techniques that have proved satisfactory in one area may not find similar successful application elsewhere. For this reason it is felt that much more can be accomplished by some consideration of future oil recovery possibilities rather than by an enumeration of past results, many of which are generally known.

We are prone many times to forget that there are other methods for increasing oil recovery in addition to air and gas injection, and water flooding. The large measure of success obtained in operations, such as the dewatering of the Kern River field, is a splendid example of what may be accomplished by combining engineering ability with some pioneering spirit. The rejuvenation of this field, after it had been idle for almost 15 years, is an accomplishment of major significance in which the operating company can take justifiable pride.

The results of previous underground oil mining experiments in Pennsylvania are not considered to be economically successful. Surface excavations of oil-bearing strata in Alberta, where the overburden is thin and can be removed at reasonable cost, are being continued, but the remoteness of these great deposits constitutes a handicap that, undoubtedly, will retard large-scale development for a considerable period. It is believed, however, that there is ample justification for the development of an oil mine at some strategic place in the United States that would be planned and developed with the specific purpose of supplying the maximum amount of technical information regardless of economic yield. Definite information on the best use of explosives, the question of uncontaminated cores, selective plugging of and selective injection into rock strata, and many other matters connected with the completion and reworking of wells, and the injection of fluids into oil-bearing rocks, should be obtained from such an operation. It is believed that an experimental mine, of the type the writer suggests, should provide specific facts on the measures that must be taken to recover a given amount of oil at a given cost, just as is being done with regard to shale oil in the experimental mining operations in Colorado. Such being the case, it would seem that there could be no better opportunity for the federal government to be of substantial assistance to the oil industry in the performance of basic research than by the sponsorship of an experimental oil mine.

Immediate opportunities undoubtedly exist for working shallow, little depleted crude. Such operations might include partial or complete excavation, experiments in the application of heat, and possibly the preliminary dilution of the reservoir fluid with light crude to make the heavy oil more mobile, and, thus, easier to remove with moderate pressure differentials. Actually, there is an amazing amount of heavy, viscuous crude in shallow reservoirs in various parts of the United States that cannot be produced by conventional secondary methods because the reservoir rock strata cannot withstand the excessive pressure necessary to remove the oil in its natural state. The urgent demand for heating oils should certainly provide a good incentive for a careful consideration of methods whereby known reserves of heavy crude may be recovered efficiently and profitably.

Virtually all methods for increasing oil recovery probably will be associated in some way with the injection of fluids into oil-bearing rocks. Interesting possibilities such as: (1) The release of oil by bacterial action; (2) studies of the physical chemistry of reservoir surfaces, particularly with the objective of increasing permeability to oil, and decreasing permeability to gas and water; (3) underground hydrogenation in deeper fields to improve the mobility of reservoir fluids by the actual lightening of the hydrocarbon molecules, and others, if developed to the point of practical field application, undoubtedly will require the utilization of injection techniques that although by no means perfect, have been improved greatly by extensive utilization in secondary recovery operations. For this reason, and excepting, of course, various phases of mining operations, it cannot be foreseen how the use of wells can be avoided in almost all oil recovery projects. So long as wells will be required, much attention certainly should be devoted to the development of methods whereby existing wells can be utilized most effectively for both injection and production purposes. Too much emphasis cannot be placed on this problem, for it may not be profitable to redrill entirely an oil field for secondary recovery operations.

As wells will be an essential part of practically all secondary operations, it should be obvious that no well should be abandoned until consideration is given to the effects that such abandonment might have on future attempts to increase recovery. Also, it is believed that all new completions should be planned, even though pressure maintenance or secondary recovery are not considered to be immediately expedient, so that the wells can be employed with the least cost and trouble for any oil recovery program that may be adopted subsequently.

● **Opportunities for research.** For many years the oil industry has spent large sums in refining research, which has resulted in lowered manufacturing costs, reduced sales prices, and improved products. It would appear plausible that a similar measure of success could be expected if the same liberality should be devoted to studies of methods for increasing oil recovery. The splendid results that have been obtained from oil recovery research in Pennsylvania are

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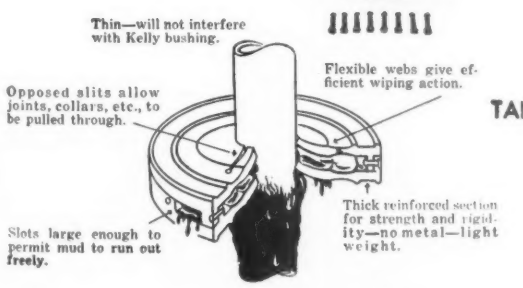
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Flexible webs give efficient wiping action.
Opposed slits allow joints, collars, etc., to be pulled through.
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Slots large enough to permit mud to run out freely.

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REPLACEABLE HALVES FOR ECONOMY—Identical halves and light hard rubber pins make up the TANDEM. Should either half become worn, only that half need be replaced. Each replacement half supplied with new pins. Halves easily assembled into rigid unit.

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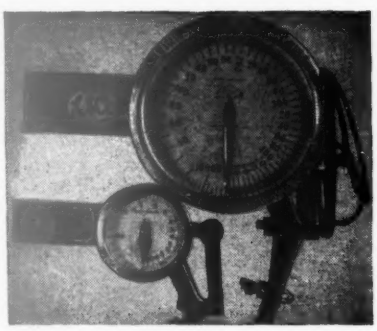

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most impressive and surely support this conclusion.

It is recognized that oil recovery research cannot be directed effectively until it is possible to evaluate better the magnitude of the problem, and to determine the conditions that may control its solution. The pioneering work by the American Petroleum Institute, which is being supplemented by the Interstate Oil Compact Commission in a coordinated program, should eliminate in the not too distant future some of the uncertainties that now prevail regarding the amount of oil contained in the reservoirs of United States fields, and the amount that might be susceptible to the application of improved recovery technology. It is suspected that these amounts are enormous, and that oil in place may possibly exceed the total past production plus the present proved primary reserves of the nation.

The recent publication by the Arkansas Oil and Gas Commission of a report on "Secondary Recovery of Petroleum in Arkansas—A Survey," by Fancher and Mackay[8], can be cited as an example of what a state investigation can do to encourage increased oil recovery. This report shows that the secondary reserve of Arkansas is almost equivalent to the recognized primary reserve, a most significant fact when the current low rate of discovery of new fields is considered.

The study of recovery possibilities of Arkansas oil fields can be commended to every state that may be concerned about the future of its petroleum industry. The results of this study, also, provide convincing evidence that there need be no conflict in purpose or objectives between research sponsored by the state and industrial research. Arkansas has made a definite contribution of basic information to its oil industry, which would have been difficult and expensive for any individual or company to duplicate. At the same time, this work in no way discourages private initiative, and, as a matter of fact, the encouragement that has been given to industry to utilize more effectively the proved resources of the state under the enlightened oil and gas laws of Arkansas, which have served as a model for legislation in other states, is an example of true conservation that deserves profound appreciation.

It is quite probable that the average American never gave thought that there might be any scarcity of oil until he was given a book of coupons during the war years and was told how much and for what purpose he could drive his automobile. For this reason, it is, perhaps, unfortunate that it is not possible to observe directly the depletion of oil and gas reservoirs. The significance of soil erosion, destruction of forests, and depletion of mineral resources occurring at the surface cannot be easily overlooked, and such loss to the nation of valuable resources is generally recognized and understood. If we could be provided with the same ability to observe the production of oil, the fact would be most impressively revealed that petroleum is very abundant, that the supply is usually not exhausted when primary production has declined to a marginal stage, and that all that is needed to make at least some of this remaining oil available is recovery technology that may be applied profitably. Therefore, it may well be that actual shortages of oil will serve a good purpose by emphasizing that special measures to augment the present available crude supply will be necessary to provide security for any emergency that can be anticipated.

If proved sources of oil can receive adequate study by inventive technologists, the United States will be provided with a form of creative mechanism that so far, in the entire history of the country, has never had to admit failure.

The notable part that the American Petroleum Institute has taken in the study of methods for increasing oil recovery is certainly deserving of recognition both by the government and by industry. From its inception, the work of the Standing Subcommittee on Secondary Recovery Methods has received unfailing and enthusiastic support from the officers and directors of the Institute and from the petroleum industry. Had it not been for this support and cooperation, it would not now be possible to discuss with any measure of assurance the manner in which improved recovery technology may help to provide oil for the needs of the United States and for its defense.

● **Acknowledgments.** The writer is most grateful to Kurt H. Anderson, George H. Fancher, Gordon H. Fisher, E. T. Heck, and L. F. Peterson, officers of the Standing Subcommittee on Secondary Recovery Methods, for helpful advice in the preparation of this paper.

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7. Report of the Advisory Committee on Secondary Recovery, *Interstate Oil Compact Commission Quarterly Bulletin*," Vol. VI, Numbers 3 and 4, page 91.
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(a) In the Glossary of Terms and Definitions on Secondary Recovery, page 255 of the API book on "Secondary Recovery of Oil in the United States," Secondary Recovery is defined as follows:

"Secondary recovery is the oil, gas, or oil and gas recovered by any method (artificial flowing or pumping) that may be employed to produce them through the joint use of two or more well bores. Secondary Recovery is generally recognized as being that recovery which may be obtained by the injection of liquids or gases into the reservoir for the purpose of augmenting reservoir energy; usually, but not necessarily, this is done after the primary recovery phase has passed." ★ ★ ★

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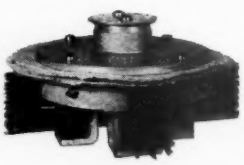

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Please Mention The Petroleum Engineer

U. S. Steel Seeks Ore Deposits

Benjamin F. Fairless, president of United States Steel Corporation, and John G. Munson, vice president of United States Steel Corporation of Delaware in charge of raw materials, are leaving today for Rio de Janeiro for the purpose of inspecting certain ore deposits in South America, particularly in Brazil and Venezuela.

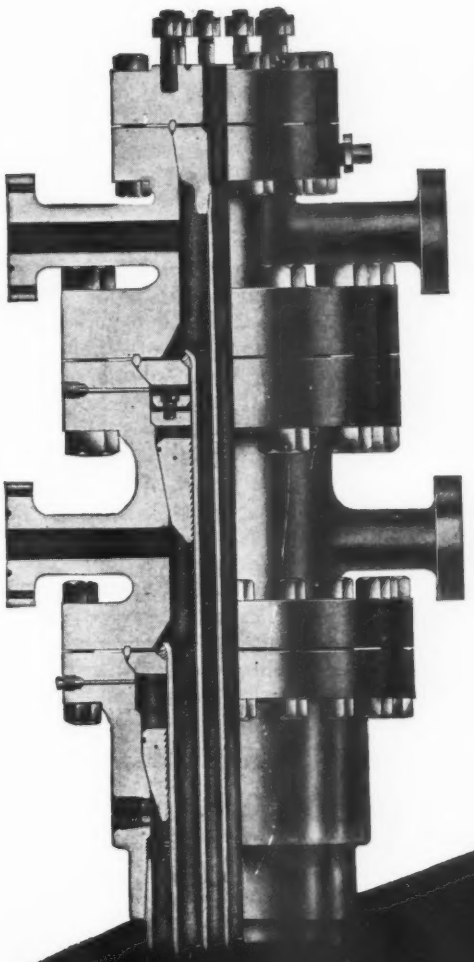
Promptly after V-J day United States Steel resumed its practice of seeking to obtain full information about all known foreign deposits of iron ore that might be utilized in the future to supply the American steel industry. This exploration is undertaken in order to supplement and increase the life of reserves of iron ore in Minnesota and elsewhere in the United States.

For some time past, United States Steel has been carrying on extensive exploratory drilling in districts south of the Orinoco River in Venezuela where known iron ore deposits of considerable magnitude exist, and has acquired mining concessions in these districts from the government.

***Record-breaking attendance** is scanned at the recent meeting of the Petroleum Division of the AIME in Dallas, Texas, by: (l to r) Carl A. Young, director of the API and member of AIME; William E. Wrather, president of AIME and director of the USGS in Washington; Mrs. Nowland, secretary, and William H. Strang, executive secretary of Petroleum Division of AIME. More than 880 persons registered at the three-day meeting, the largest number that ever attended an AIME division meeting.*

***AIME petroleum division** meeting in Dallas, Texas: Irwin W. Alcorn, chairman of the petroleum division of the Institute and chief engineer for the Pure Oil Company at Houston; and Warren J. Jackson, chairman of the North Texas section of the AIME, which served as host for the division meeting. Jackson is petroleum engineer for Lane-Wells, Dallas.*

No SOFT SPOTS in RECTORHEADS



Casing and tubing heads are no place for soft, resilient seals. You have too much at stake to entrust these vital between string seals to anything less than the RECTORHEAD "RING OF STEEL," provided by a good weld plus API ring gasket.

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***NEW OFFICERS** of American Association of Oilwell Drilling Contractors elected at the eighth annual meeting in Houston are, l to r, standing: Zach K. Brinkerhoff, Jr., Brinkerhoff Drilling Company, vice-president for Rocky Mountains; Karl L. Kellogg, K. L. Kellogg and Sons, Compton, vice-president for California; H. L. Rowley, Big Chief Drilling Company of Mississippi, Shreveport, vice-president for Cretaceous and Tertiary basins; retiring association president E. C. Brown; Brad Mills, executive vice-president; J. Doyle Settle, secretary; and D. B. Ferguson, Ferbanta Drilling Company, Carmi, Illinois, vice-president for cable tools, and seated: Louis A. Beecherl, McDaniel and Beecherl, Dallas, treasurer; C. F. Whaley, Chet Whaley Well Servicing Company, Houston, vice-president for well servicing; J. V. Dunbar, Dunbar Drilling Company, Salem, Illinois, vice-president for Illinois, Michigan, Indiana and Kentucky; Joe S. Morris, Allen and Morris, San Antonio, President; Al Buchanan, Al Buchanan Drilling Company, San Antonio, vice-president for Gulf Coast; A. W. Thompson, Thompson-Carr, Inc., Houston, vice-president for West Texas and New Mexico; and Marion S. Church, Dallas, general counsel.*

Officers not shown are: Frank M. Porter, Fain-Porter Drilling Company, Oklahoma City, vice-president-at-large: and R. W. Wire, Loffland Brothers Company, Tulsa, vice-president for central Mid-Continent.

Organize Petroleum Engineering Fraternity

University of Oklahoma petroleum engineering students have organized a new honorary fraternity, Pi Epsilon Tau. Membership is composed of under graduate students majoring in petroleum engineering, graduate students of petroleum engineering, and honorary members to be chosen from technical graduates with outstanding achievements in the field. President of the founding chapter is Robert Penner. Dr. John C. Calhoun, Jr. serves as faculty adviser.

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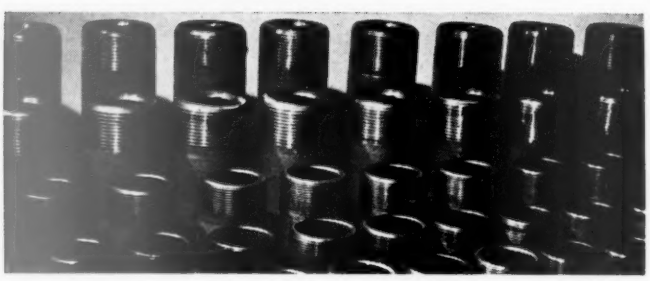

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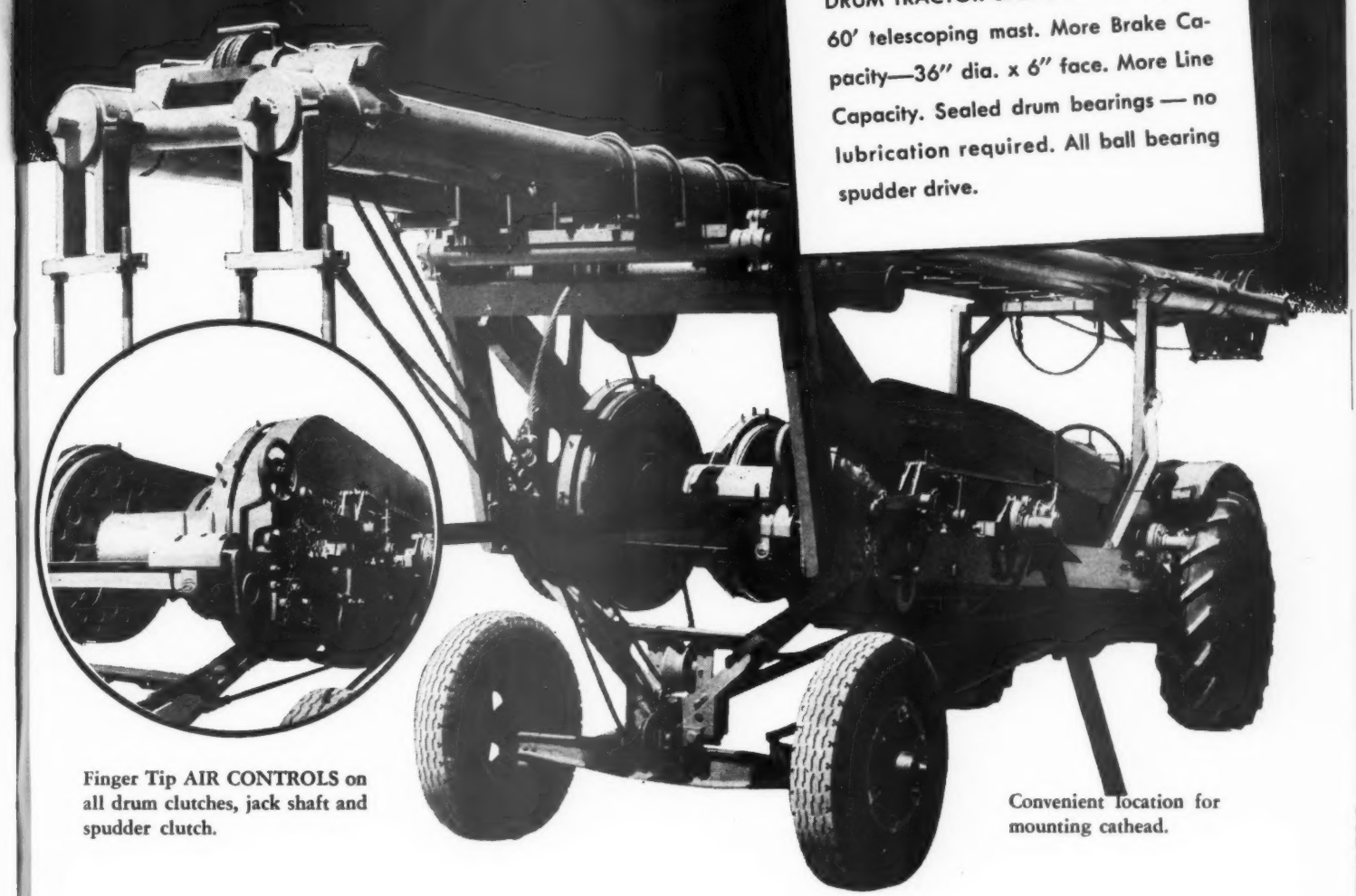

Finger Tip AIR CONTROLS on all drum clutches, jack shaft and spudder clutch.

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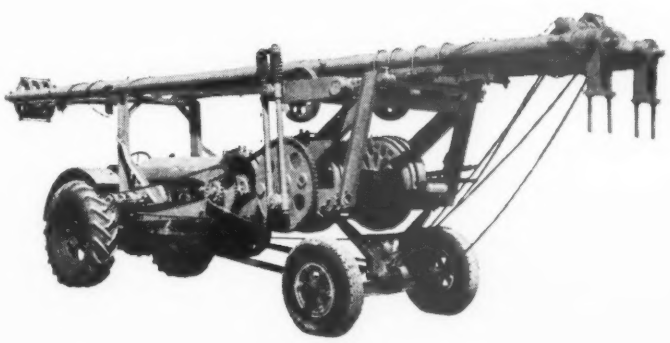
It's the *newest* and most workable self-powered Spudder available. The new type drum drives eliminate long chains, as drive is direct from jack shaft to double sprocket on rear drum, and front drum is driven by a *short* chain from the double sprocket. When spudder is operating all drum drive chains are dead.



A longer, heavier front axle sets the wheels over the spindles with spindle carrier bearings facilitating easier steering. Note truck-type easily removable rims on the front wheels.

This unit has 4 road speeds, with top speeds of 15 or 30 m.p.h. optional.

We would like to show you the many other new features of this unit.

Vickers Appointed

Mud Products, Inc., of Tulsa, Oklahoma, distributors of mud and mud handling equipment, announced the appointment of W. G. Vickers to its sales and engineering staff, according to E. R. "Dick" Albert, general manager.

Vickers served 14 years in the field in drilling and production, and until his present association with Mud Products he served with Baroid in the specialty department.

With headquarters in Henderson, Texas, Vickers will cover the southeast Texas area and parts of Louisiana.

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Lane-Wells salutes the API with striking billboard

During October and early November, highway travelers in and near the nation's oil fields will see this striking billboard, posted by Lane-Wells to call attention to the tremendous work of the American Petroleum Institute and to lend further emphasis to the Institute's theme, "Petroleum Promotes Progress." The design is carried out in four shades of blue, with tan, pale yellow, red, and white.

Posted at carefully chosen locations in 10 states—Texas, California, Oklahoma, Arkansas, Kansas, Louisiana, Mississippi, Wyoming, New Mexico and Illinois—the poster will be seen not only by oil field men, but by tens of thousands of other automobilists. This is the sixth design in a series to be posted this year by Lane-Wells, who are believed to be the first oil field service company to employ a consistent schedule of outdoor posters to carry messages to oil country men.

Secondary Recovery Meeting at Bradford, Pennsylvania

More than 125 oil men attending a recent three day conference at Pennsylvania State College were told that experiments in the Bradford, Pennsylvania, laboratory of the Pennsylvania Grade Crude Oil Association kindle hope of additional oil being recovered from formations in the Kane-to-Butler area of Pennsylvania whose oil content has been depleted by gas injection under pressure.

Dr. J. N. Breston, chief of the Bradford laboratory, reported that tests on long samples of Venango oil sands from Pennsylvania's middle district subjected to injection of water under pressure following gas drives, indicate that from 7 to 12 per cent of the oil in place can be recovered.

Studies in progress at the Bradford laboratory offer the possibility that fewer wells will have to be drilled in a given area to provide balanced drainage of the oil reservoir, Willard Johnson, laboratory staff member, reported in another paper prepared in collaboration with Dr. Hughes.

Johnson disclosed that experiments in the Penn Grade laboratory have revealed that flow of fluid through long oil bearing sands may be from 25 to 30 per cent less in one geographic direction than in another. For instance, the maximum flow in the sand from one well tested was in a northwest-southeast direction.

Seventeen papers and reports were presented by representatives of the school of mineral industries of the college, the oil association laboratory, and the U. S. Bureau of Mines station at Franklin, Pennsylvania. Dr. A. W. Gauger, director of the college's mineral industries experiment station, presided at the annual dinner. An open forum on producers problems was held as the closing feature.

Honolulu Oil Changes

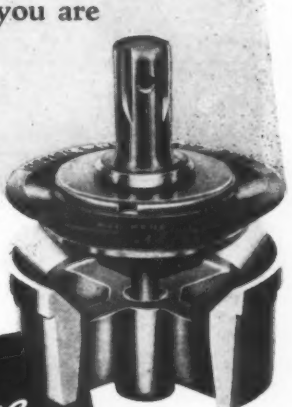
Honolulu Oil Corporation through Alden S. Donnelly, manager of the Texas division, announced recently that Leo M. Brady had been promoted to head of the Texas division land and tax department. Oliver Haag was appointed assistant land and tax man in the company's Midland, Texas, office.

This insert on either valve means better slush pump service!

The Mission Compound-308* Valve Insert lasts longer under all conditions. As a result valve failures are minimized and your slush pumps work more efficiently for longer periods of time.

This insert is used on either of Mission's two great valves. Choose the valve best suited to your operating conditions and use it with confidence, for you are assured of getting the best valve service available.

MISSION *Slush Pump* VALVES



MISSION *Silver Top* SLUSH PUMP VALVE

. . . features a replaceable, wear-taking bushing that makes it the most economical valve on the market for general service.

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Bethlehem changes

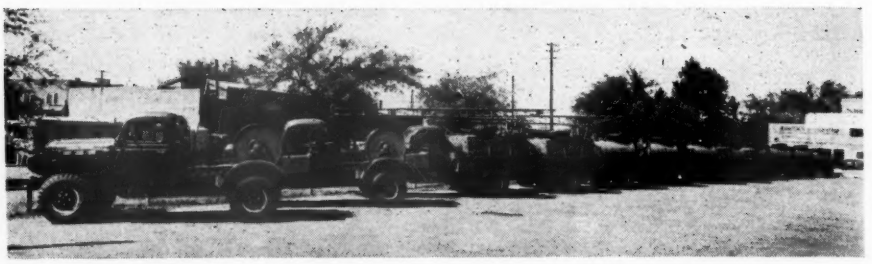
Bethlehem Supply Company announces the promotion and transfer of several field personnel.

J. Kelly Davis, formerly district engineering representative in Louisiana Gulf district, has been promoted to assistant district manager of the same district. Prior to his affiliation with Bethlehem in August, 1944, Kelly Davis was employed by the U. S. Engineers for two years.

W. B. House, formerly store manager and field representative at Shreveport, Louisiana, has been transferred in the same capacity to the Odessa, Texas, store. Bruce House has been with Bethlehem for seven years.

Bill Pickering, formerly store manager and field representative at Winnsboro, Texas, has been transferred in the same capacity to the Shreveport, Louisiana store.

W. Q. Mitchell, formerly store manager and field representative at Carthage, Texas, and more recently field representative out of the Shreveport, Louisiana, store, has been transferred and promoted to store manager and field representative of the Winnsboro, Texas, store. W. Q. Mitchel has a long service record with Bethlehem, having been with the Company since February, 1930.



***A fleet of trucks** equipped for use in geophysical operations in foreign fields are shown above as they were assembled recently in the Griffin Tank & Welding service yard in Dallas, Texas, for shipment abroad. These trucks are designed to negotiate not only desert sand but also heavy mud and include: (l to r) reel trucks for geophone cables, combination shooting and loading trucks, and combination shooting and water tank trucks. The combination shooting and loading trucks have a mast and small drawworks for lowering shots into deep shot-holes and pulling casing.*

Compact to Meet December 9-11 at Wichita

The Interstate Oil Compact Commission will hold its next quarterly meeting, its annual meeting, at Wichita, Kansas, on Thursday, Friday, and Saturday, December 9, 10, and 11, with headquarters for the meeting at the Allis Hotel. Committee meetings will be held on December 9. General sessions will be on December 10 and 11.

The general theme of the meeting will be "Conservation of Natural Gas." Program details will be announced by Governor Beauford H. Jester of Texas, chairman of the Compact Commission. The problems of natural gas conservation are probably more urgent than ever in history —they are of vital importance to the Compact Commission and everyone concerned with the prevention of waste of our natural resources. This meeting will be one of the most important ever held by the compact, according to Earl Foster, executive secretary.

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Learning Your Clutch Needs
Analysing the Problem
Designing the Clutch
Planning Production
Tooling Up
Manufacturing
Checking and Testing
Supervising Installation
Servicing
Automotive and Aircraft
Trucks and Busses
Tractors and Road Machines
Farm Machines and Implements
Oil Field Rigs and Pumps
Industrial
Mowers and Light Machines
Engines and Marine Units
Machine Tools
Production Units
Your power control and transmission requirements, whatever they may be, will benefit from clutches that are exactly suited to their needs. Thousands of manufacturers — in hundreds of industries — have found that the right ROCKFORD CLUTCHES increase the efficiency of their machines. Our engineers are not restricted to any one type or size of clutch — but are free to specify one that is best suited to the particular operating essentials of your product. Write for our latest bulletin.
ROCKFORD CLUTCH DIVISION
BORG-WARNER
1313 Eighteenth Street, Rockford, Illinois

IT'S SIMPLE,
IT'S FLEXIBLE,
IT'S OIL-RESISTANT

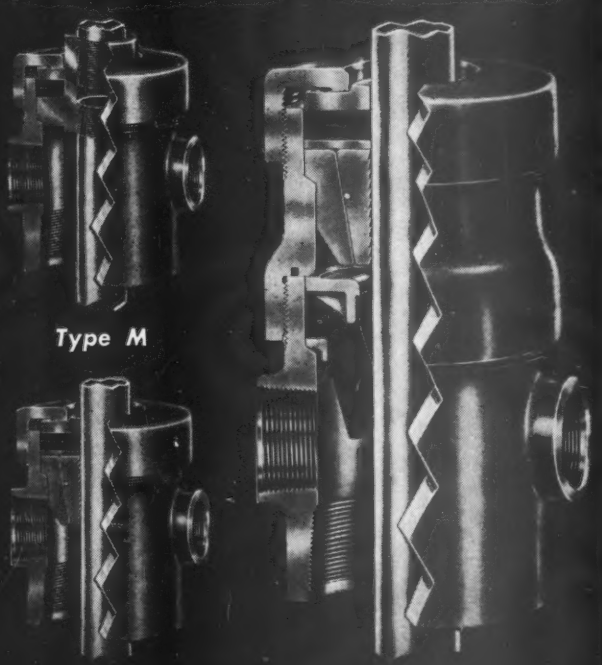
. . . and pulling, running or rotating

LARKIN STRIPPERS ARE STRONGER . . . LAST LONGER

For those three reasons . . . because Larkin stripper rubbers are simple in design, flexible and oil-resistant . . . you will find that they reduce *maintenance cost* and *maintenance trouble* because Larkin stripper rubbers give twice the service life of any other stripper. Besides, it serves as a blow-out preventer, an oil-saver and a positive pressure seal. This dependable-design Larkin stripper is just another reason why Larkin Forged Steel Tubing heads offer more for your money than any other tubing head. They're the best buy in the low pressure field. Compare and buy Larkin Forged Steel Tubing Heads through your supply store.

LARKIN PACKER CO., INC. ST. LOUIS, MO.

LARKIN *Forged Steel* TUBING HEADS



Type M

Type R

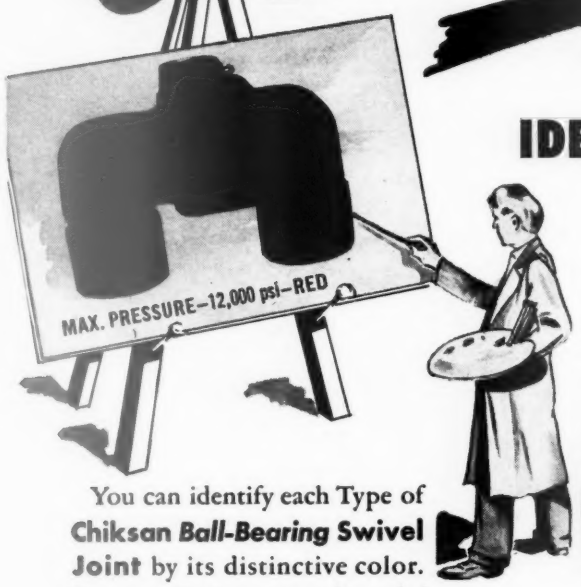
Type SR

The same Larkin Forged Steel Tubing Head serves dependably from completion to depletion . . . on flowing, gas-lift or pumping wells.

LARKIN
...Through Your Supply Store

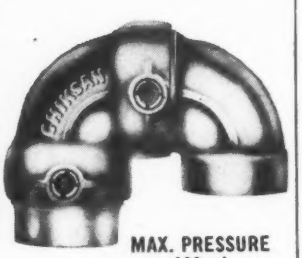
COLOR

FOR EASIER IDENTIFICATION

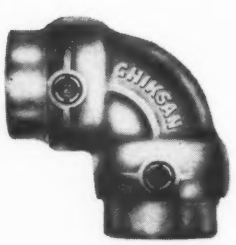


You can identify each Type of **Chiksan *Ball-Bearing* Swivel Joint** by its distinctive color. Pressure Ratings are *color-coded* as follows:

MAXIMUM PRESSURE, 300 psi . . . . . GREEN
MAXIMUM PRESSURE, 1,000 psi . . . . . BLUE
MAXIMUM PRESSURE, 3,000 psi . ALUMINUM
MAXIMUM PRESSURE, 12,000 psi . . . . . RED
MAXIMUM TEMPERATURE, 500° F, 700 psi . . . . . YELLOW



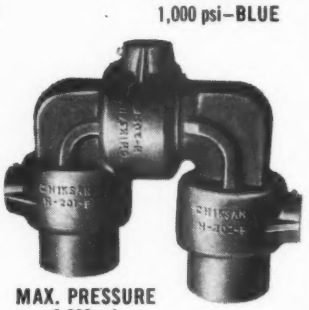
MAX. PRESSURE 300 psi GREEN



MAX. PRESSURE 1,000 psi—BLUE

WRITE FOR THE NEW CHIKSAN CATALOG which gives complete data.

MAX. TEMPERATURE 500°F—700 psi—YELLOW



MAX. PRESSURE 3,000 psi ALUMINUM

REPRESENTATIVES IN PRINCIPAL CITIES

WELL EQUIPMENT MFG. CORP. HOUSTON 1, TEXAS
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CHIKSAN EXPORT CO. BREA, CALIFORNIA • NEW YORK 7
EXCLUSIVE EXPORT REPRESENTATIVE

CHIKSAN TRADE MARK
BALL-BEARING SWIVEL JOINTS FOR ALL PURPOSES

CHIKSAN COMPANY
BREA, CALIFORNIA
New York 7 Houston 1

Store Manager Named

Guy L. Green, former bookkeeper for The Continental Supply Company at Refugio, Texas, has been named manager of the company's Raymondville, Texas, store. He replaces G. W. Patterson, who has been transferred to Alice, Texas, as field salesman.

Acquires Drench

National Foam System, Inc., Philadelphia, foam fire fighting manufacturers, has announced the purchase from Arnold, Hoffman and Company, Inc., Providence, Rhode Island, of its goodwill, patents, formulae and trademark covering the wetting agent known throughout all industrial and forest fire fighting fields as Drench.

Drench will be immediately manufactured at the company's principal plant at West Chester, Pennsylvania.

National Foam System specializes in foam fire protection in the petroleum, chemical, marine, aviation and other industrial fields, and says this new product will greatly increase the effectiveness of water.

Hamilton-Thomas Created

Formation of the Hamilton-Thomas Corporation, Hamilton, Ohio, to operate Economy Pumps, Inc., Klipfel Manufacturing Company, and Liberty Planers, Inc., has been announced.

Officers of the corporation are Richard Thomas, president; L. G. Thomas, executive vice president; H. R. Ryan, vice president; R. H. Thomas, Jr., vice president; E. T. Drinkuth, secretary; and L. V. Thomas, treasurer.

Creation of the Hamilton-Thomas Corporation as the operating organization is part of a widespread expansion program in the manufacture and distribution of products.

Standardized Lube Names

The first world-wide system for standardizing both specifications and brand names of marine and industrial lubricants has been adopted by Shell Oil Company, B. G. Symon, lubricants manager, announced. Now used by all companies in the Shell group the world over, the system makes it possible for operators of American-built machinery in other countries to obtain lubricants with the same brand names and specifications recommended in the United States for use with marine and industrial equipment.

American machinery is coming into wider and wider use all over the world, Symon said, and a line of products with standard brand names and specification limits will do much to simplify the problems of insuring proper lubrication for machines that are far from normal sources of supply.

"THE CUP AND FUNNEL BOYS"

BARNEY TELLS EVERYONE ABOUT THE GEL STRENGTH OF DRISCOSE*!

WELL—

it's the

WHOLE TRUTH

DRISCOSE is used as a water loss controlling agent
. . . in calcium contaminated muds
. . . in salt contaminated muds
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DRISCOSE permits drilling with greatly reduced mud problems and lower total mud cost.

DRISCOSE assures thin, tough filter cake

Write today for data

DISTRIBUTORS

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Mud Control Laboratories, Inc., Oklahoma City, Oklahoma
Atlas Production, Inc., Los Angeles, California

***DRISCOSE** is a trade name for Sodium Carboxymethylcellulose

DRILLING SPECIALTIES COMPANY

BARTLESVILLE, OKLAHOMA

Creole Contracts for Fleet of Workboats

A contract for the construction of a fleet of 51 all welded steel workboats was awarded to Churchward and Company, Inc., builders of *Steelcraft* cruisers, by the Creole Petroleum Corporation, a subsidiary of Standard Oil Company of New Jersey, it was announced here by Jack Churchward, president. Total value of the contract is in excess of $1,000,000.

The vessels, which range in size from 32-ft launches to 50-ft tug boats, will be used in the Venezuelan operations on Lake Maracaibo where Creole Petroleum has underway an extensive and long range program.

The largest part of the contract deals with the construction of nineteen 50-ft tugs, heavy duty workboats built of ¼-in. steel plate and designed to stand by the offshore drilling rigs in all weathers. Powered with 170-hp, 6-cylinder Buda diesel engines, these 50-footers will resemble the conventional tug boat both in appearance and performance. Dollar-wise, this section of the construction program amounts to about $660,000.

3 uses!
1–Paraffin Scraper
2–Sucker Rod Guide
3–Traveling Valve Guide
A
This popular American Sucker Rod Coupling and Paraffin Scraper actually gives you three efficient tools wrapped into one! Whether you're pumping, pulling or running, you'll find it will not hang up—or cause excess tubing wear! The body is made of alloy steel drop forged; the barrel of special seamless tubing heat treated to over 400 Brinnell.
Available through your supply store.
A
DISTRICT OFFICE: HOUSTON, TEXAS
AMERICAN IRON AND MACHINE WORKS CO.
Oklahoma City — Box 1177 — L. D. 518

API Holds 28th Annual Meet

The nation's leading oil and gas men converged on Chicago November 8 for the American Petroleum Institute's 28th annual meeting in the Stevens Hotel and the Palmer House. close to 5000 delegates were present at the many technical, group and general sessions scheduled for the four day period through Thursday, November 11.

One of the highlights of the big meeting was a comprehensive report on the long-term availability of crude oil for American consumption. This report, for the first time, forecasts the oil production potential on a per barrel basis. It sets forth specific figures embracing the next 10 years.

The report, prepared by a subcommittee of more than 75 members who delved into every facet of the petroleum industry, was made Thursday morning, November 11, by the group chairman, L. F. McCollum, president of Continental Oil Company, Ponca City, Oklahoma.

McCollum also addressed the general session and analyzed the report in its relationship to the everyday user such as the automobile owner, the householder, the farmer and others.

Robert G. Dunlop, president of Sun Oil Company, Philadelphia addressed the Thursday morning general session too, as did Max Ball, of the Oil and Gas division of the Department of the Interior. Dunlop spoke on "Three Peas in a Pod—Prices, Profits, Productivity in Petroleum." Ball talked on "Government For the People."

Wednesday's two general sessions at 2:30 p.m., and 8 p.m., were featured by the addresses of five prominent industry and government leaders.

William R. Boyd, Jr., president of the American Petroleum Institute, led off with his annual report at the afternoon session, and was followed by Dr. Robert E. Wilson, chairman of the board of Standard Oil of Indiana who told "How the Oil Supply Problem was Licked."

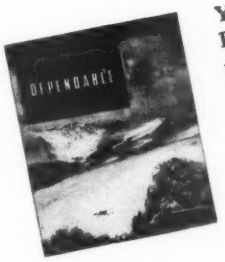
President Boyd then presented the API's "Gold Medal for Distinguished Achievement" to Dr. Charles F. Kettering, noted General Motors scientist, for his many contributions to mankind. Dr. Kettering, third recipient of the API medal, addressed the general session afterwards.

In the evening, Sen. George W. Malone (R) Nevada, and Frank M. Porter, prominent Oklahoma oil man, exchanged views. Senator Malone spoke on "Congress Looks at the Petroleum Industry," while Porter, president of Mid-Continent Oil and Gas Association, responded with "The

What makes a job Tough

Hard rock . . . fast round trips . . . continuous operation. That's when Cummins Diesels "pay off". . . in fast footage at low cost.

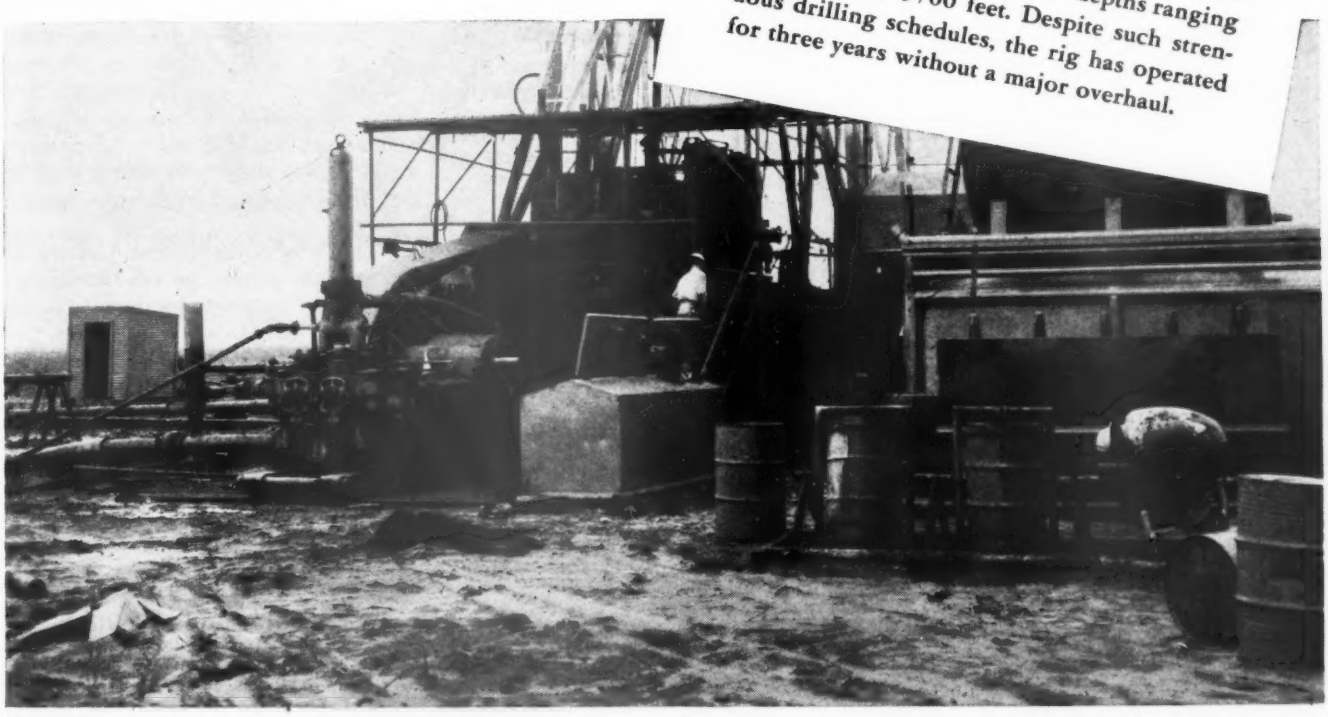
CUMMINS DIESEL
SINCE 1918...PIONEER OF PROFITABLE POWER THROUGH HIGH SPEED DIESELS



Your Cummins Dealer will show you other examples of the performance of Cummins Diesels in the current issue of *The Dependable Diesel.*

Advance Drilling Company, Fort Worth, Tex., finds Cummins Diesels better for its job. In heavy-duty drilling operations in Slaughter Field, near Sundown, Tex., a U-15 Unit rig, powered by two Model LI-600 Cummins Diesels, is used.

This Cummins-powered rig, in a period of 16 months, drilled 12 wells to depths ranging from 4525 to 5700 feet. Despite such strenuous drilling schedules, the rig has operated for three years without a major overhaul.



CUMMINS ENGINE COMPANY, INC. • COLUMBUS, INDIANA

Petroleum Industry Looks at Congress."

Another highlight of the Wednesday evening session was a panel interview of members of the petroleum industry by six well-known radio commentators. The commentators were Elmer Davis, head of the wartime OWI, Alex Drier, Ray Henle, Richard Harkness, J. J. Stroud and Dwight Weist.

Tuesday's group sessions also attracted considerable attention.

Eugene Ayers, of the Gulf Research and Development Company, Pittsburgh, Pennsylvania, delivered a comprehensive paper on the "Major Sources of Energy" before the Division of Refining. This report discussed all known sources of energy available to man, including atomic energy.

The Division of Transportation, whose meetings were held in the Palmer House, heard Joseph F. Farley, commandant of the U. S. Coast Guard, talk about the "Regulation of the Movement of Oil by Water" and William T. Faricy, president of the Association of American Railroads, on "The Railroads and the Petroleum Industry" in its Tuesday morning session.

In the afternoon, Clyde B. Aitchison, of the Interstate Commerce Commission, and Clifford A. Hahn, general industrial negotiator of the Office of Industry Cooperation, U. S. Department of Commerce, spoke. Hahn discussed a vital industry problem "The Allocation of Steel in Petroleum Transportation."

The Division of Production, in its Tuesday meeting, had key addresses by E. G. Gaylord, of the California Research Corporation, San Francisco, whose subject was the "Role of Research in the Production of Oil;" R. H. Hargrove, of the Texas Eastern Transmission Corporation, Shreveport, Louisiana, on the "Importance of Natural Gas in the National Economy of the United States," and John R. McNulty, of the Ohio Oil Company, Casper, Wyoming, on "Do You Recognize Your Employes as People?"

While Monday's sessions generally were devoted to technical symposiums, the Division of Marketing sponsored three interesting addresses. They were: "The Need for the Individual Businessman in the National Economy" by Theodore O. Yntema, research director for the Committee For Economic Development, Chicago; "Business Aids for Dealers and Jobbers," Charles H. Wible, of the Edwin K. Williams Company, Chicago, and "The Current Supply Position," John M. Boatwright, of Standard Oil Company, of Illinois, Chicago.

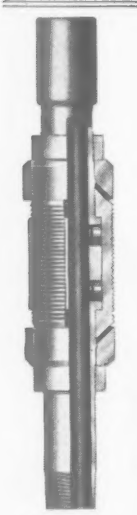
Accident prevention, fire protection and highways also were discussed at special sessions during the four-day meeting.

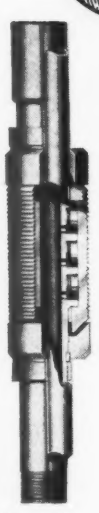
Sheet Steel Mill for California

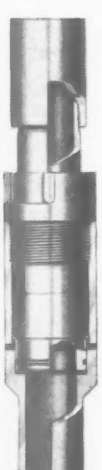
J. Lester Perry, president of Columbia Steel Company, U. S. Steel subsidiary, announced recently that Columbia Steel Company took possession from the War Assets Administration of the site of its future cold reduction sheet mill in the Los Angeles district.

This site, located near Columbia's existing steel mill at Torrance, California, consists of more than 200 acres of land and various buildings that were used to house an aluminum plant during the war. The buildings will be rearranged to serve the needs of a modern sheet steel mill. Work on such reconstruction will commence immediately.

The equipment for the new sheet mill has been under order for many months and is now being manufactured. It is expected that the mill will be completed and in operation sometime in 1950. It will have an annual capacity for the production of more than 300,000 tons of cold reduced sheets of various kinds.


Type "B" Tubing Anchor


Type "C" Tubing Anchor


Tubing Drain

On & Off Attachment

PAGE TENSION TOOLS

Announcing...

PAGE TENSION TYPE PRODUCTION TOOLS at your D + B and CONTINENTAL SUPPLY STORES

PAGE "TENSION TYPE" Production Tools—Tubing Anchors, Tubing Drains, and Sucker Rod On & Off Attachments—are available in the Mid-Continent through your nearest D+B and Continental Supply Stores. Check these new Tools. Get the *full* story on how Page Tools can cut production costs by keeping tubing in the hole longer!

PAGE TOOLS ARE *different*

TYPE "B" ANCHOR for ROD PUMP STRINGS: Page Type "B" Tubing Anchors set hydrostatically as the well pumps up!

TYPE "C" ANCHOR for MAIN AND PARALLEL STRINGS: Page Type "C" Tubing Anchors embody the same operation advantages as the Type "B" *plus* a special design for anchoring *both* main and parallel strings!

DRAIN AND BUMPER SUB COMBINED: Page Combination Tubing Drain and Bumper Sub affords a means of draining the tubing above the pump and can also be used as an effective up-jar!

ON & OFF ATTACHMENT for SUCKER RODS: Page's unique On & Off Attachment joins sucker rods to pump *after* tubing run-in—releases quick whenever desired!

FIELD RECORDS PROVE . . .

. . . that anchoring the Page Way *increases* pump efficiency and *decreases* equipment wear —visit your nearest D+B Pump Store or Continental Supply Store — find out how Page "Tension Type" Tools can help *you!*

Mid-Continent Distributors

D+B Division—Emsco Derrick & Equipment Co., Garland, Texas

The Continental Supply Company Dallas, Texas

PAGE OIL TOOLS, Inc.

3356 Lime Ave., Long Beach 7, Calif.

T.W.I. Pump Chamber . . .

. . . greatly reduces mud line surge and makes possible the compounding of power slush pumps.

Using a construction completely unlike the conventional surge chamber, the T.I.W. Pump Chamber practically eliminates pulsations in high pressure mud lines. It lengthens life of mud lines and rotary hose as well as making possible the compounding of power slush pumps.

The T.I.W. Pump Chamber is proved by two years of successful field service. Write for full information.

TIW *Pump Chamber*

Patent Pending

TIW *Announces two* GREAT NEW PRODUCTS

TIW *Mudmaster*

Patent Pending

This revolutionary mud mixer requires only ten horsepower to do the mixing job that normally requires a 40 horsepower slush pump with the conventional mud gun.

Driven by either a steam turbine, electric motor or internal combustion engine, a propeller agitates the mud in the pit while vanes on the shaft break up the weighting materials, clay and chemicals being fed.

Like all other T.I.W. products, the mud mixer is proved by actual field service before being announced.

TEXAS IRON WORKS

Manufacturers of: T.I.W. Portable Rigs . . . T.I.W. Safety Joints . . . T.I.W. Rotary and Casing Slips . . . T.I.W. Grief Stem Safety Valves . . . T.I.W. Packers for every purpose . . . and many other oil field tools.

GENERAL OFFICE and MAIN PLANT: 1401-1423 Maury Street, Houston 10, Texas
Other Shops at Victoria and Corpus Christi
EXPORT REPRESENTATIVE: Val R. Wittich, 30 Rockefeller Plaza, New York, N. Y.

Joins Security

Otto Hammer, president of Security Engineering Company, Inc., of Whittier, California, announces the appointment of R. E. "Jimmie" James as New York division manager for the company. He will have his headquarters in the company's office in New York City, situated in the Chanin Building, and will have charge of export sales of Security drilling and production equipment.

R. E. James

"Jimmie" has a rich background of experience in the oil industry, having spent his entire business life in the oil field equipment business. He was with National Supply Company for four years and with Oil Well Engineering Company for 16 years. In this latter capacity he was assistant and deputy to the general sales manager of the company.

Opens New Offices

Herb J. Hawthorne, Inc., Houston, Texas, makers of Hawthorne replaceable blade bits and "Rock Cutter" blades, announce the opening of their new offices and warehouse, at 2001 Harold Street.

Hawthorne replaceable blade bits are produced at the factory, which remains at its present location, 5003 North Shepherd Drive, Houston.

Made Sales Manager

The appointment of A. H. Knight as sales manager of the Franks Manufacturing Corporation, Tulsa, Oklahoma, is announced by R. M. White, vice president in charge of sales. Knight has spent more than ten years with major supply stores and has had considerable field experience since becoming identified with the petroleum industry in 1929. He was with the Oil Well Supply Company for eight years and was with the International Derrick and Equipment Company the last year and one half.

A. H. Knight

In the Navy four years during the war, much of the time overseas, he was discharged with the rank of lieutenant commander.

Knight will have his headquarters at the Franks main office in Tulsa.

Double LOCKS FOR Double SAFETY

The New Regan Dualock Tubing Elevator

Tubing can never drop when you use this newly-designed elevator. Even if the door is not locked a positive-acting safety latch rotating with the lock keeps tubing locked within the elevator. Regular door lock has double locking faces. No other elevator has this patented two-way safety design. Body is a heat treated, solid alloy steel casting designed with a 4 to 1 safety factor. Engineered and produced to rigid Regan Standards, Pre-tested under every field condition. Now, proved in performance by users, the Regan *Dualock* Tubing Elevator is the number-one choice of operators who demand maximum safety. *Send Today for Detailed Bulletin.*

Regan Quality E-1

Forge & Engineering Co.

SAN PEDRO, CALIF. HOUSTON, TEXAS

Exclusive Mid-Continent Representatives:
Hunt Tool Co.,
P.O. Box 1436, Houston, Texas

Exclusive Export Representatives:
Hunt Export Co., 19 Rector St., New York, N. Y.
Avda Pte., R. Saenz, Pena 832, Buenos Aires, Argentina

Statement of the Ownership, Management, Circulation, etc., Required by the Acts of Congress of August 24, 1912, and March 3, 1933, of
THE PETROLEUM ENGINEER

Published monthly at Dallas, Texas for October 1, 1948.

State of Texas, County of Dallas, ss.

Before me, a Notary Public in and for the State and county aforesaid, personally appeared W. T. Bryan, who, having been duly sworn according to law, deposes and says that he is the business manager of

THE PETROLEUM ENGINEER

and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, to-wit:

1. That the names and address of the publisher, editor, managing editor, and business managers are:

Publisher: The Petroleum Engineer Publishing Co., P.O. Box 1589, Dallas, Texas.

Editor: K. C. Sclater, P.O. Box 1589, Dallas, Texas.

Managing Editor: Ernestine Adams, P.O. Box 1589, Dallas, Texas.

Business Manager: W. T. Bryan, P.O. Box 1589, Dallas, Texas.

Advertising Manager: T. J. Crowley, P.O. Box 1589, Dallas, Texas.

2. That the owner is a partnership composed of W. T. Bryan, T. J. Crowley, W. L. Love and K. C. Sclater, all of Dallas, Texas, doing business under the name of The Petroleum Engineer Publishing Company.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustees or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has an interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

W. T. Bryan, Business Manager.

Sworn to and subscribed before me this 29th day of September, 1948.

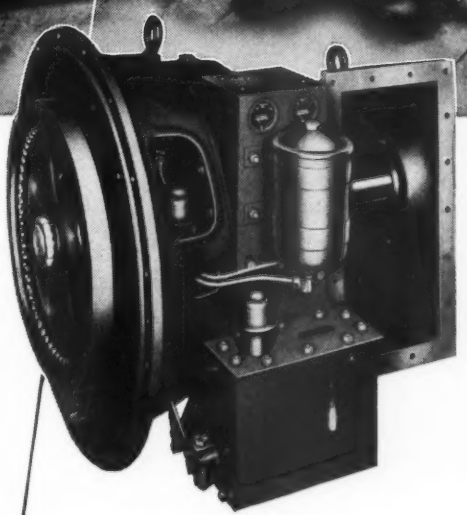
[Seal] Edwina H. Cameron
(My commission expires June 1, 1949.)

MATCHING BIT SPEED TO FORMATION HARDNESS

Matching drill bit speed with the hardness of the rock formation has been simplified in the oil fields by installing Twin Disc Hydraulic Torque Converters between power units and rotary tables. The use of a Twin Disc Hydraulic Torque Converter makes possible precise adjustment of table speed between the high and low limits of the table drive transmission.

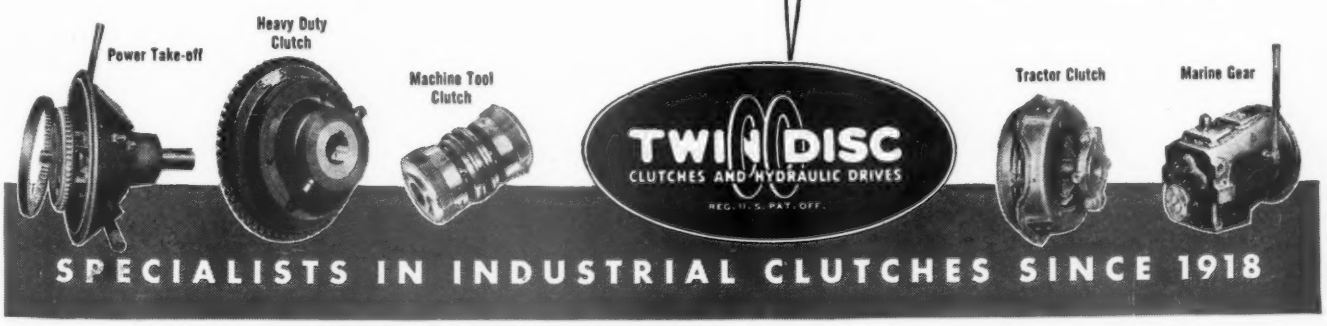
There is no rigid connection in a Twin Disc Hydraulic Torque Converter between driving and driven parts. The power is delivered to the rotary table entirely through fluid mass and motion. Shock loads cannot be transmitted back to the engine, nor can torsional vibrations or other irregularities of power flow reach the rotary table and drill bit. Therefore, a perfectly smooth application of power is assured to govern the speed of the table according to the varying formations through which your drilling may pass.

For full information on the Twin Disc Hydraulic Torque Converter, write the Hydraulic Division, Rockford, Illinois, for Bulletin No. 135-B. TWIN DISC CLUTCH COMPANY, Racine, Wisconsin.



Twin Disc Hydraulic Torque Converter (Lysholm-Smith type).

A Twin Disc Hydraulic Torque Converter transfers power from a Cummins Diesel to the rotary table on this Ideco Hydro-Rotary Drilling Unit. It is operated by the Phillips Petroleum Co., in the TXL Field near Odessa, Texas.



SPECIALISTS IN INDUSTRIAL CLUTCHES SINCE 1918

running tour with men in the industry

▸ **J. Doyle Settle,** secretary of the American Association of Oilwell drilling contractors, Dallas, was recently elected head of the newly created drilling and exploration safety group in the petroleum section of the National Safety Council.

Settle was named when the new group was formed during the thirty-sixth National Safety Congress held recently in Chicago. He also directs the Association's industry-wide safety program.

▸ **R. W. (Bob) Shira** was promoted to assistant export manager of Byron Jackson Company, Patterson-Ballagh Division, it was announced by J. C. Ballagh, vice president.

Bob was formerly in the service division at Patterson-Ballagh, later becoming advertising manager. He then entered the California sales division in the Los Angeles Basin, where he was active until his recent promotion.

▸ **Tom Lawrence Turner** has been appointed as oil country representative for Gorman-Rupp.

In 1930 Mr. Turner entered the oil field as civil engineer with the Pure

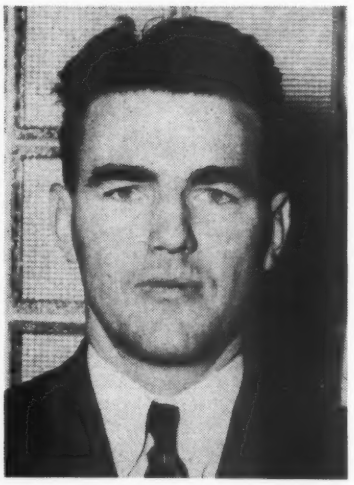
Tom Lawrence Turner

Oil and was with United Gas Public-Service Companies until 1937. He then joined the International Supply Company at Hobbs, New Mexico and, when this organization was purchased by the Bethlehem Supply Company, he became the first manager at their new store at Avoca, Texas.

In 1942 he became purchasing agent for the J. G. White Engineering Corporation. He then joined the editorial staff of the Oil Weekly. During 1944 he became district manager for American Iron and Machine Works.

▸ **Paul D. Torrey,** petroleum engineer, has been elected president of Lynes, Inc., which has hydraulic packer tools for oil and gas wells. General offices are in Houston, Texas.

▸ **Robert A. Cunningham,** senior mechanical engineering student at Rice Institute, was awarded the American Petroleum Institute, Houston Chapter scholarship for 1948 at a



R. A. Cunningham

recent meeting in Houston. Selection of the most outstanding engineering student at Rice for the annual award is based upon scholarship, character, leadership, and ability. Professor L. B. Ryan of Rice Institute headed the scholarship committee.

Cunningham, the son of a retired Presbyterian minister, was a navy flier during World War II, spending most of his two-years' active duty in the central Pacific with a patrol-bomber squadron. Bob has always been an honor student.

He entered the engineering school at Rice Institute in March, 1946, and was elected to Tau Beta Pi, honorary engineering society in April, 1948. He was also awarded the Franklin Scholarship at Rice for outstanding scholastic standing in his class. T. J. Fuson, Humble Oil and Refining Company, chairman of the Houston Chapter, made the award.

▸ **Fred Shield,** San Antonio, Texas, newly elected president of the Independent Petroleum Association of America, recently announced that the following important posts in the IPAA had been filled by the election of prominent Texas oil men.

The vice presidents elected were Clyde H. Alexander, Creslenn Oil Company, Dallas, for the northeast district; J. P. Coleman, McCarty and Coleman, Wichita Falls, north district; R. C. Kay, Amarillo, panhandle district; Robert L. Wood, Frontier Chemical Company, Midland, permian district; K. D. Owen, Houston, south east district; and L. A. Nordan, San Antonio, for the southwest district. All will serve for the 1948-49 year.

Those elected to the executive committee were Dilworth Hager, Dallas; C. P. McGaha, Fain and McGaha, Wichita Falls; Maston Nixon, Southern Minerals Corporation, Corpus Christi; Cecil L. O'Brien, Nabob Oil and Gas Company, Amarillo; Bryan W. Payne, Iowa-Payne Oil Company, Tyler; H. J. Porter, Houston, and J. Ed. Warren, Carl B. King Drilling Company, Midland, Texas. Fred S. Sehmann, president of the National Stripper Well Association, Wichita Falls, is an ex-officio member of the executive committee.

Shield, Merle Becker, W. C. McBride, Inc., St. Louis, Missouri, retiring president; Russell B. Brown, Washington, D. C., general counsel; C. E. Buchner, Tulsa, Oklahoma, executive manager; H. B. Fell, Simpson-Fell Oil Company, Ardmore, Oklahoma, executive vice president; and D. R. Snow, Barnsdall Oil Corporation, Tulsa, newly elected treasurer, are also ex-officio members of the executive committee.

▸ **R. H. McPeake** of S.A.T.I.C. of Buenos Aires, representatives of the Oil Well Supply Company and Chicago Pneumatic in Argentina, is on a business trip in the United States.

▸ **M. B. "Muz" Standing,** California Research Corporation, La Habra, California, has been appointed general chairman of the Pacific Coast district of API, spring meeting to be held in Los Angeles May 12-13, 1949, according to announcement by Lot Bowen, Pacific Coast district chairman of API's division of production.

M. B. Standing

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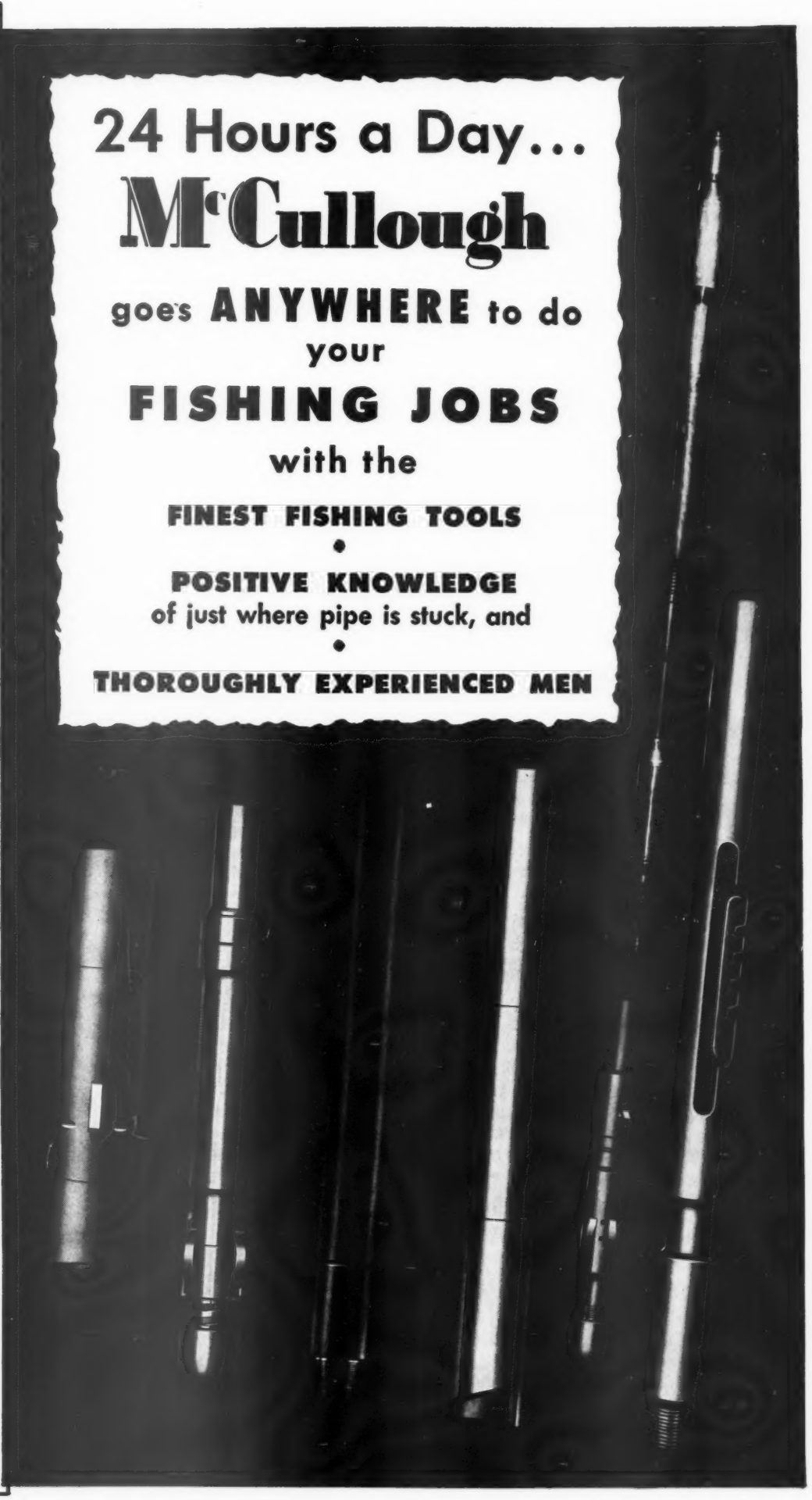


PERSONALS

George Miller, president of Oil Base, Inc., makers of Black Magic oil base drilling fluid, left for South America where he plans to confer with principals of Petro-Tech Service Company, at Caracas, Venezuela, who are the export representatives for Oil Base, Inc.

Miller will visit most of the producing areas in Venezuela, Colombia, Ecuador and the northwest section of Peru at Talara. He will return via Mexico City to consult with the heads of G. Saevedra E. Hijos, distributors for Black Magic and OB Mud Guns in Mexico.

Louis A. Beecherl of McDaniel and Beecherl Drilling Company, Dallas, Texas, was recently elected chairman of the new Fort Worth-Dallas section of the American Association of Oilwell Drilling Contractors. Other officers of the new section are: Thomas J. Carter of the Thomas J. Carter Drilling Company, Dallas, vice chairman; and Roscoe Everidge of Davidson Drilling Company, Fort Worth, secretary.

L. A. Beecherl

Charles L. White has been appointed sales engineer in the Tournarope sales department for R. G. LeTourneau, Inc., Peoria, Illinois. He will be the company's representative in Texas, New Mexico, Arizona, Colorado, Utah, and Oklahoma for Tournarope applications and sales.

Associated with the wire rope industry for the past 20 years, White was with the Bridgeport Machine Company, Wichita, Kansas; Williamsport Wire Rope Company, Williamsport, Pennsylvania; and Bethlehem Steel Company branch office, Houston, Texas.

As Tournarope sales representative White will headquarter at 3249 Waits Avenue, Fort Worth, Texas.

Edmund T. Flanagan, manager of New York sales division of The Fairbanks Company, has been appointed manager of regional sales in addition to his present position.

In June 1947, Flanagan was appointed manager of New York sales after serving for many years as assistant manager for the Boston branch. He has been with the company for 31 years.

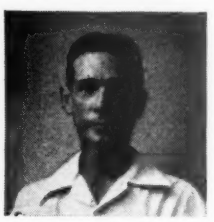
Robert Edwards, mud engineer with Oil Base, Inc., makers of Black Magis oil base drilling fluid, is making a 30-day survey for the company in Canada, and will visit all major operations. Oil Base, Inc., has long contemplated opening a branch office in Canada and Edwards' survey will have a direct bearing on the company's action.

Ralph Lesseig, sales engineer, McCullough Tool Company, has been transferred to the Rocky Mountain district where he will be district sales representative for McCullough with headquarters in Casper, Wyoming. For the past five years he has been working out of the McCullough Oklahoma City office.

Joseph H. Eustice, who has been on leave of absence for the past 12 months from the W. C. Norris Company, has announced his resignation as president of that company because of continuing ill health.

E. C. Bolger, chairman of the board, will also assume the duties as president of that company.

T. M. Smith, Jr., has been promoted to manager of field sales and service for Patterson-Ballagh Division of Byron Jackson Company for the Texas Gulf Coast. Ralph Snowden at Alice, Texas, and A. C. "Tag" Colgin at Houston will be under Mr. Smith. "Tag" will be transferred to Houston from Shreveport, Louisiana.



T. M. Smith, Jr.

Robert K. Franklin, president of the Rolo Manufacturing Company, Houston, Texas, has recently returned from an extensive tour of Canada and the Western United States, including California, Montana, and Wyoming. While in Canada, he visited Leduc oil field in Alberta for a glimpse of the famous wild well. Franklin embarked on October 2 for Venezuela and Trinidad, S.A., where he will study the oil field problems. The Rolo Manufacturing Company specializes in the manufacture of Rolo Well Checkers for the oil industry.

R. K. Franklin

Ralph M. Hoffman, president of Link-Belt Company, Pacific Division, San Francisco, California, was elected a vice-president of the parent Link-Belt Company, at the quarterly meeting of the board of directors, held in Chicago. Hoffman joined the predecessor of the Pacific Coast Company—Meese and Gottfried Company—in 1913.

R. M. Hoffman

Hoffman has served in many important executive capacities in both the parent and subsidiary companies. He continues president of Link-Belt Company, Pacific Division, the position he has held since 1943.

George S. Leonard has been appointed manager of The National Supply Company plant at Houston, Texas, succeeding **Robert E. Valk,** who has been promoted to assistant works manager of the company's plant at Toledo, Ohio.

Leonard, a native of El Paso, Illinois, is a graduate of Texas A & M, where he received his B.S. degree in mechanical engineering in 1936. He joined The National Supply Company in that year and has been with it since, except for a three-year absence during the war when he served as an officer with the U. S. Army Engineers.

Valk is a native of Muskegon, Michigan, and a graduate of the University of Michigan. He received his B.S. degree in mechanical engineering there in 1938 and later that year joined The National Supply Company at its Toledo plant. He served there in various capacities until 1945 when he was named manager of the Houston plant.

Haynes B. Ownby, president of Haynes B. Ownby Drilling Company, Dallas, Texas, was elected commander of the 169th Aero Squadron during the 29th annual reunion of that organization held recently at Dallas.

Ownby was living in Terrell, Texas, when he volunteered with the 169th, December 13, 1917. After a short training period at Love Field, Dallas, he left with the squadron, the first unit to leave that field for foreign service during World War I. He served for a short time in Canada; 8 months with the Royal Flying Corps in the British Isles and in France with Pershing's First Army during the "Big Push."

He received citations for meritorious service during the battles of The Meuse, St. Mihiel, The Argonne Forest, and The Defensive Sector.

▸ **Ray H. Anders** was appointed director of purchases of Sun Oil Company to succeed Henry Thomas, who retires December 1 after 36 years of service, it was announced by Robert G. Dunlop, Sun's president.

Anders, until recently manager of Sun's Industrial Products Department, will be assisted in his new duties by **Roy A. Hurst,** assistant director of purchases, who has been with Sun since 1916.

Thomas had been Sun's director of purchases since 1937. Prior to that appointment he had an interesting 25-year career as an engineer in several divisions of the company.

Born March 27, 1881 in Wales, Thomas came to this country at an early age. He was graduated from Kansas State College in 1904 with the degree of B.S. in electrical engineering and was given the degree of Electrical Engineer in 1918. Before coming with Sun Oil Company he was associated with Allis-Chalmers Manufacturing Company.

Anders was graduated from Pennsylvania State College with a B.S. degree in chemistry. He first was employed by the George W. Blabon Corporation (now Sloan-Blabon Company), Pittsburgh, and later served as the Allentown, Pennsylvania, manager of the B. F. Goodrich Company.

Anders became associated with Sun Oil Company in 1929 as an industrial products salesman in the Trenton (New Jersey) district. In January, 1946, he succeeded Frank R. Markley (now Sun's general sales manager), as manager of the department.

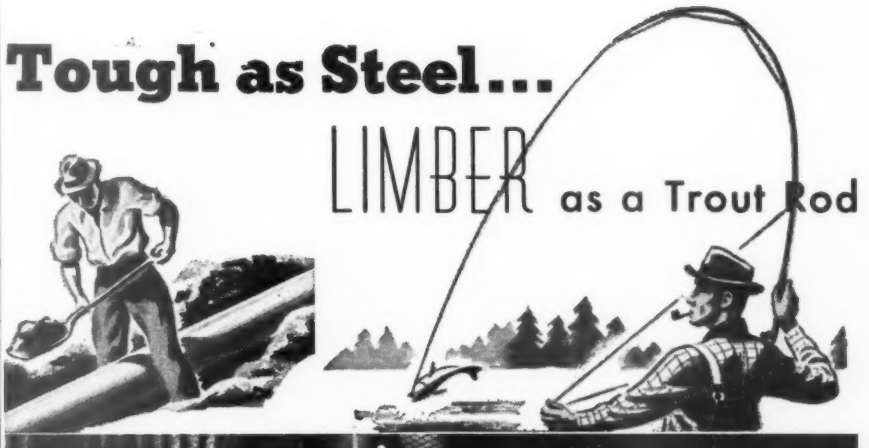
▸ **George W. Perry** has been appointed advertising manager of the Cook Electric Company, Chicago, according to an announcement by Walter C. Hasselhorn, president. Perry is a former member of the advertising department, Kellogg Switchboard and Supply Company, and an alumnus of Harvard University, Graduate School of Business Administration.

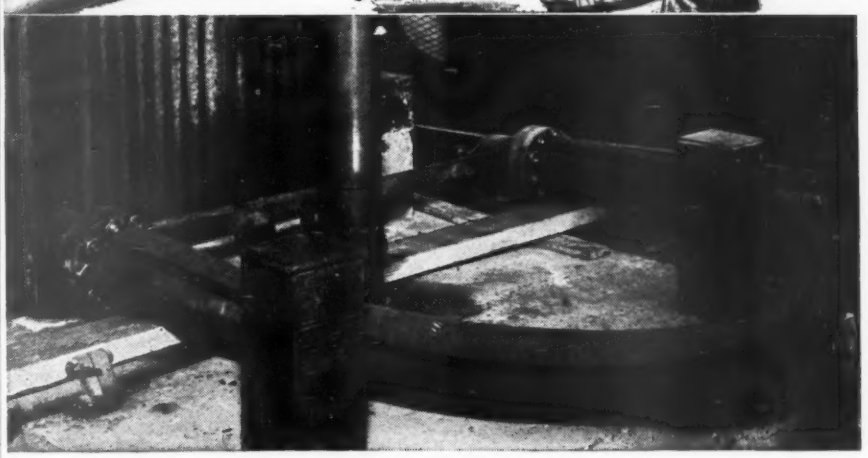
George W. Perry

The Cook Electric Company produces expansion joints for the pipe line and chemical processing industries and electrical and electronic devices for aircraft and general industrial applications. The company also maintains a completely equipped research laboratory available for cooperation with industry and the government in development work.

Tough as Steel...

LIMBER as a Trout Rod





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PERSONALS

W. F. "Pete" Slater, manager of general technical service division, Kobe, Inc., has been appointed to the newly created position of manager of hydraulic equipment sales. As head of the general technical service division, he has been responsible for the training of Kobe field personnel and the direction of the company's field service work.

Technically trained at the University of Tulsa and University of Okla-

W. F. Slater

J. T. Lewis

homa, in 1932 he took over the management of private oil production leases in the vicinity of Tulsa. He joined S. M. Jones Company in 1936.

In 1940, he joined Kobe, Inc., at Tulsa as district manager, and in 1942 moved to California to become California division manager. In 1945, he was appointed manager of Kobe's general technical service division.

J. T. Lewis, who has been with Kobe, Inc. for the past 6 years, has been transferred from Oklahoma City, where he was manager of the Oklahoma district, to Odessa, Texas, as West Texas district manager. He replaces W. C. Gilmore who has resigned to go into business for himself.

O. C. Swanson, manager of Oil Well Supply Company's Mt. Carmel, Illinois, store, was promoted to field salesman in the company's Illinois district, it was announced recently by C. H. Maynard, Eastern Division manager for this U. S. Steel subsidiary. He is succeeded by David E. McCarthy.

James T. Neal, 61, assistant secretary-treasurer of The National Supply Company, Pittsburgh, died in Tulsa, Oklahoma, September 23, following a heart attack. Neal had been with National Supply Company 41 years, most of which were spent in Oklahoma. In 1925, after three years in Tulsa, he was transferred to Independence, Kansas, as division credit manager, later to Toledo, Ohio, as general credit manager, and in 1931 back to Tulsa as assistant secretary-treasurer.

Don A. Klemme, safety supervisor for Stanolind Oil and Gas Company, has been named general chairman of the National Safety Council's petroleum section for 1948-49. Announcement of Klemme's selection was made at the 36th National Safety Congress held in Chicago last week.

Klemme has served the petroleum section as vice-chairman for production, drilling and exploration for the past three years.

A native Iowan, Klemme's interest in safety began in 1929 when he was made a safety man for Midwest Refining Company, Midwest, Wyoming. In 1933, he became a Stanolind safety man, and in 1936 was appointed to the newly-created post of safety supervisor for the Stanolind organization.

Walter C. Beadle has been appointed manager of the acidizing department of The Western Company, H. E. Chiles, Jr., owner of the concern, has announced.

Beadle has been with The Western Company for five years. He was formerly the manager of Western's south district in Odessa. Beadle will be located in the company's general offices in Midland.

Other promotions announced by Chiles were: J. S. Caffrey to manager of the south district, Frank Turner to station manager at Odessa, and C. E. Smith to manager at Levelland.

John H. Batten was recently elected president of Twin-Disc Clutch Company. P. H. Batten, formerly president and chairman of the board

J. H. Batten

P. H. Batten

of directors, will continue his active interest in the company as chairman of the board.

John H. Batten has been associated with the Twin Disc Clutch Company since 1935, working in various departments and in the general offices. He has been a member of the board of directors since 1937.

Other officers re-elected are: Soren Sorenson, vice president, manufacturing; N. F. Adamson, vice president, sales and engineering; G. L. Shuman, secretary-treasurer; R. T. Rehwald, assistant secretary; and R. T. Howell, assistant secretary.

George E. Purdy, formerly with General Chemical Company, has joined the staff of the Tretolite Company Research Laboratory at St. Louis, Missouri. Purdy will be engaged in the investigation of corrosion problems, and in the development and application of Tretolite's new Kontol Corrosion Inhibitors.

George E. Purdy

Purdy is a graduate of the University of Missouri, School of Mines and Metallurgy, and a member of Alpha Chi Sigma. He holds a degree of Bachelor of Science in chemical engineering. During World War II he served four years with the Army, including a year in the European theatre in the Corps of Engineers.

L. A. Dixon has been appointed to the vice presidency of the Rockwell Manufacturing Company's meter and valve divisions, according to W. F. Rockwell, Jr., president.

W. F. Rockwell, Jr.

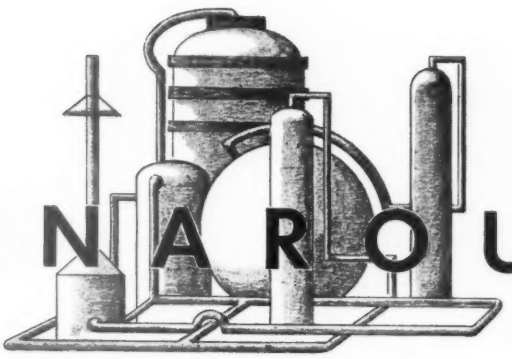
Dixon is well known in the utility, petroleum and municipal markets, having done considerable field work in the promotion of the Company's products for the past 20 years. He was associated with the Wisconsin Axel Company and started at the Pittsburgh Equitable Meter Company, now a division of Rockwell Manufacturing Company, in 1926, as assistant to the president.

Later, he was president of the Pittsburgh DuBois Company, manufacturers and distributors of gas meters. When that company was acquired by the Rockwell Manufacturing Company, he continued to serve in the same capacity until recently, when he relinquished that position to accept the new assignment.

William H. Starbuck has been appointed assistant general sales manager of the Kellogg division of the American Brake Shoe Company, according to an announcement by William T. Kelly, Jr., division president.

Starbuck, formerly sales representative, has served in various sales capacities since first joining the company. A native of Cleveland, Ohio, he attended Kent School and Yale University. He will be located at the division's headquarters in Rochester, New York.

THE TURNAROUND



Synthetic Fuels—A Research Opportunity, Not A National Emergency

A great deal of Big Print has been employed in recent years, to show the remarkable strides in the perfecting of processes for synthesizing petroleum, which employ the so-called Fischer-Tropsch reaction. New chemical engineering techniques have been applied, methods unknown to the Germans such as the fluid catalyst principle; new operating conditions have been adopted, which produce entirely different yields of desirable materials. From the statements of authorities in the field the conclusion could have been drawn in recent years that the battle is all over but the shouting. That is the Big Print.

A colored man speaking of insurance policies is quoted, "De big print gives it to ye, and de fine print takes it away." Now, hard-headed technologists are looking at the Fine Print, are finding so much that the prospect falls far short of the ready-made large-scale practical process that has been held up before our eyes. For example, the process as now operated produces far too large a proportion of methane, ethane, and products lighter than motor fuel. As much as 25 per cent of the total yield may be made by secondary polymerization of olefins formed in the primary reaction; average molecular weight of total product is between ethane and propane. If conditions are changed to lower this gas yield, too much paraffin wax is formed.

Many other problems are met, say Eugene Ayres and collaborators in a recent paper; metallic iron catalyst is changed gradually to magnetite, Fe_3O_4; the composition of the heavy products changes as the catalyst continues on stream, the reason for which is unknown. Loss of heat value is very high; 100 Btu of starting material results in 40 Btu in motor fuel, 50 Btu in total liquid products. Cooling water required is 29 to 36 gals per gal of product, with resultant pumping, treating, cooling, and other costs. Oxygen cost alone is estimated at $1.25 per bbl of product, or 3 cents per gal.

The Bureau of Mines reported recently on a program for implementing our industry to produce a million barrels of synthetic oil daily. The Bureau estimates this will cost $8.7 billion using coal as raw material; some technical executives say this estimate is entirely inadequate. They say, too, that our technology is inadequate now to warrant building such extensive capacities.

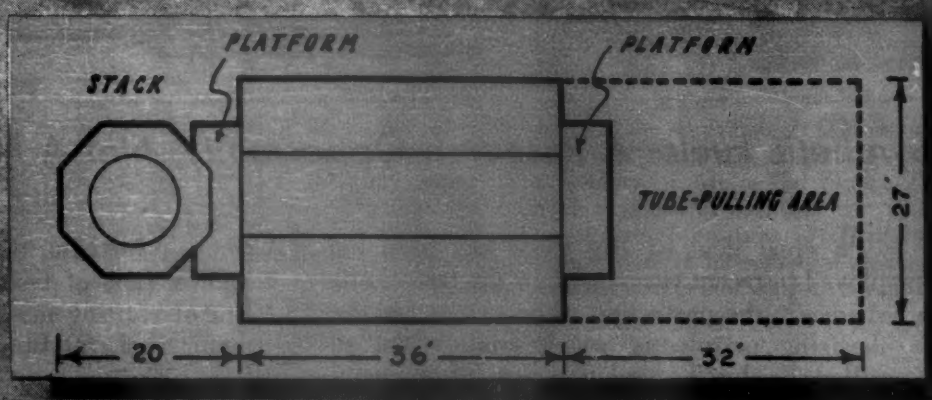
Technologists believe too much of our research has followed too closely in the footsteps of the German scientists. We probably have applied our outstanding chemical engineering abilities to process ideas that are inferior, that include inherent limitations and difficulties that prevent needed improvements.

We should pursue assiduously the quest of more knowledge of fundamental chemical engineering facts, should perfect more efficient processes in small and large-scale operations. In the present state of the synthesis art and science these large plants will be rendered obsolete in a very few years; better to build one large experimental unit, from which practical data may be obtained than to build a great number, all of which will become obsolete before another emergency arises.

Arch L. Foster

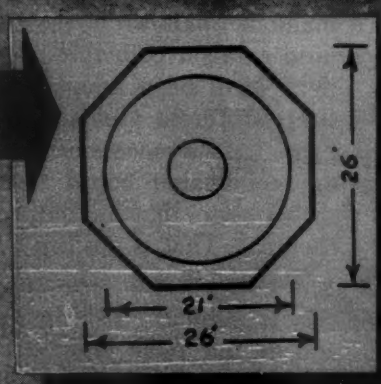
PETRO-CHEM ISO-FLOW FURNACES ARE PRE-EMINENT WHERE GROUND SPACE IS A FACTOR . . . . . *and it always is!*

Ground space plan for average box-type furnace of 50 million BTU/hr capacity



THE SAVING IN GROUND SPACE IS OBVIOUS!

Ground space plan for average Petro-Chem Iso-Flow furnace of 50 million BTU/hr capacity

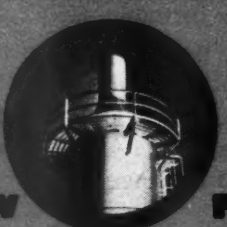


Did you ever try to cramp additional equipment into the confines of an existing refinery, or plan the layout of equipment for a new plant . . . if you did, you know the importance of every square foot of ground space.

Compare the ground space required for a box-type furnace (including the necessary space for tube-pulling, stack and platforms) with that of a Petro-Chem Iso-Flow Furnace of identical capacity. The net saving of space is considerable.

The vertical design of the Iso-Flow Furnace eliminates the need of ground space for platforms, stack and tube-pulling.

Petro-Chem Iso-Flow Furnaces require a minimum of ground space and are unlimited in size, capacity and duty.



PETRO-CHEM ISO-FLOW FURNACES

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Representatives: Bethlehem Supply Co., Tulsa and Houston • Lester Oberholtz, Calif.
H. B. Foster Co., Pittsburgh • Foxhills-Lovalty Corp., Chicago

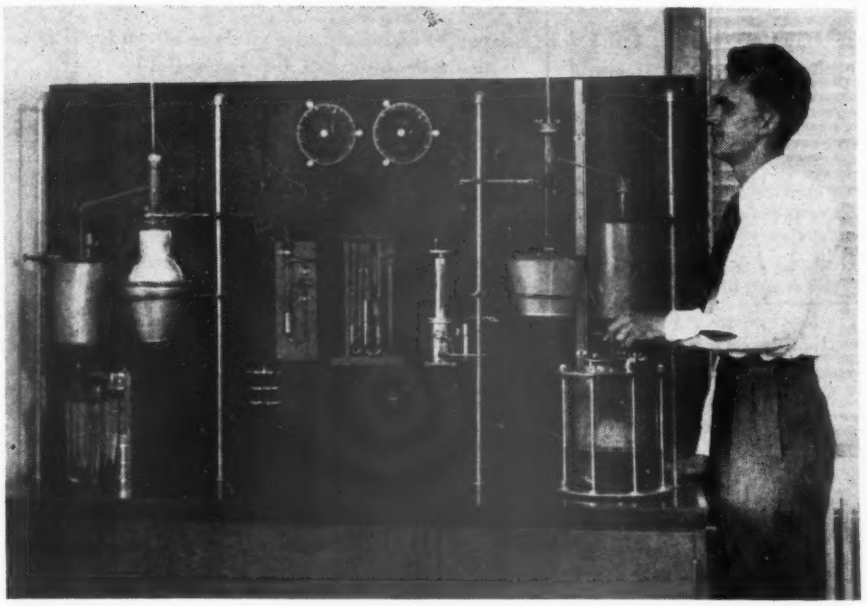


FIG. 1. Apparatus for Bureau of Mines routine analyses of crude oils. Note pressurized receiver on distillation unit (right). The unit on the left is for vacuum distillation. Operator is W. J. Wenger of Bureau of Mines.

Crude Oils of Wyoming

JOHN S. BALL and RALPH H. ESPACH

Petroleum and Oil Shale Experiment Station,
Bureau of Mines, Laramie, Wyoming

WYOMING crude oils generally are divided by practical oil men into two groups—the "green oils" and the "black oils." The former term refers to oil which is generally green, has a low sulphur content, is rather paraffinic, and yields appreciably higher amounts of straight-run gasoline. The "black oils," on the other hand, are black, have high sulphur contents, are asphaltic, and yields lesser quantities of straight-run gasoline. While this division is useful, additional information may be gained by further classification, especially with regard to the geologic age of the formation in which the oil is found.

Wyoming has more than 140 producing fields[4], many of which have been discovered in the last few years. In a large proportion of the fields production is from more than one formation; and in one, the Lost Soldier field, there are 13 productive zones in 8 formations. Consequently, many varieties of oil having somewhat different properties have been produced in the state.

The Bureau of Mines has analyzed crude oils for the last 30 years by substantially the same method.[2] These analyses permit comparison of oils produced in different sections of the country and in different countries with assurance that the same method of analysis was used. New methods of interpretation[5] have been developed which make the older analyses even more valuable. Analyses of crude oils from the Rocky Mountain region were first published by the Bureau of Mines in April 1921. Since 1930, more than 200 crude oils have been analyzed at the Laramie Station.

Laboratories in the Rocky Mountain region generally are located at relatively high altitudes. Consequently, distillations at atmospheric pressure in such laboratories are likely to deviate considerably from those at sea level. Analyses at different pressures are very difficult to calculate to a comparable basis. A pressurized system whereby the distillation can be carried out at sea-level pressure has been developed[6] by the Bureau of Mines and promises to obviate this difficulty. Fig. 1 shows the apparatus. Many of the analyses used in this report were made before this apparatus was developed and, accordingly, may be in slight error as to true values. Care has been taken in selecting the data presented to minimize the possibility of erroneous deductions.

Two crude-oil analyses representing large production and illustrating the "green" and "black" oil classifications are shown in Tables 1 and 2. The Lance Creek field is the second largest in the State from the standpoint of total production, and the Sundance sandstone is one of its principal producing formations. The oil is light gravity and low sulphur, and contains

The Authors

John S. Ball

The authors of this valuable addition to the studies of Wyoming crude oil properties are both veteran U. S. Bureau of Mines staff members. John S. Ball joined the government agency after his graduation in 1938 and Ralph H. Espach has been with the organization since 1926.

Ball is a native of Texas who received his B. S. degree in chemical engineering in 1934 and his M. S. in organic chemistry in 1936 from the Texas Technological College. For two years he took advanced work at the University of Colorado. He joined the Bureau of Mines as a junior chemical engineer and was stationed at Laramie, Wyoming, where he is now refinery engineer in charge of petroleum chemistry and refining studies. At the Petroleum and Oil-Shale Experiment Station, Laramie, his work includes study of the sulphur compounds of petroleum, development of analytical methods and research on the composition of shale oil.

Ralph H. Espach

Espach is an Easterner, going from his native Pennsylvania to study at New York University, where he received a B. S. degree in civil engineering in 1921, an M. S. in petroleum geology in 1922, and an M. E. in 1927. His first position with the Bureau of Mines was at Bartlesville as a petroleum engineer. In 1935 he was transferred to Laramie. With Harry D. Nichols he wrote the most comprehensive study of Wyoming fields that has yet been published. This Bulletin No. 418 is a review of all fields up to 1939 and present plans are to add to it in the future. As engineer in charge of the oil and gas production section of the Laramie Station, Espach devotes his time to studies whose purpose is to increase recovery of oil from reservoirs.

TABLE 1. Bureau of Mines routine analysis of crude oil from Basal Sundance sandstone of Lance Creek field.

Lance Creek field — Sample PC-48-24 — Wyoming
Basal Sundance sandstone — Niobrara County
3794-3903 ft — SE¼ Sec. 32, T. 36N., R. 65W.

General Characteristics.

Specific gravity....0.800 — API gravity... 45.4
Sulphur, per cent... 0.05 — Pour point..... 30 F
Saybolt Universal viscosity at 100 F, 36 sec. — Color..brownish-green

Distillation, Bureau of Mines Hempel Method.

Distillation at atmospheric pressure, 760 mm. — First drop, 37 C (98 F)

Fraction no.	Cut at C	Cut at F	Per cent	Sum, per cent	Sp. gr. 60/60 F	°API 60 F	C. I.	S.U. visc., 100 F	Cloud test, F	Aniline point, C
1	50	122	1.1	1.1	0.645	87.9				
2	75	167	2.5	3.6	0.655	84.5	0.4			
3	100	212	6.3	9.8	0.697	71.5	10			
4	125	257	10.4	20.3	0.728	62.9	16			
5	150	302	8.5	28.8	0.749	57.4	18			
6	175	347	7.4	36.2	0.765	53.5	19			
7	200	392	6.1	42.3	0.778	50.4	19			
8	225	437	5.7	48.0	0.790	47.6	19			67.2
9	250	482	5.9	53.9	0.804	44.5	21			71.6
10	275	527	7.4	61.3	0.815	42.1	21			75.0
Distillation continued at 40 mm.										
11	200	392	2.7	64.0	0.835	38.0	27	40	25	79.2
12	225	437	5.3	69.3	0.837	37.6	24	43	35	
13	250	482	4.6	73.9	0.845	36.0	24	52	55	
14	275	527	4.3	78.2	0.861	32.8	29	66	75	
15	300	572	5.2	83.4	0.871	31.0	30	105	90	
Residuum			14.0	97.4	0.908	24.3				

Carbon residue of residuum, 2.5 per cent; carbon residue of crude, 0.4 per cent.

Approximate Summary.

Light gasoline	Per cent 9.8	Sp. gr. 0.688	°API 74.2	Viscosity
Total gasoline and naphtha	42.3	0.735	61.0	
Kerosine distillate	19.0	0.804	44.5	
Gas oil	9.0	0.837	37.6	
Nonviscous lubricating distillate	9.8	0.843–0.870	36.4–31.1	50–100
Medium lubricating distillate	3.3	0.870–0.877	31.1–29.9	100–200
Viscous lubricating distillate	0.0	....	....	Above 200
Residuum	14.0	0.908	24.3	
Distillation loss	2.6			

TABLE 2. Bureau of Mines routine analysis of crude oil from Madison limestone of Elk Basin field.

Elk Basin field — Sample PC-48-41 — Montana
Madison limestone — Carbon County
4838-5797 ft — NW¼ Sec. 35, T. 9 S., R. 23 E.

General Characteristics.

Specific gravity.... 0.885 — API gravity... 28.4
Sulphur, per cent... 1.92 — Color..brownish-black
Saybolt Universal viscosity at 100 F, 62 sec, at 77 F, 77 sec. — Pour point, below 5 F

Distillation, Bureau of Mines Hempel Method.

Distillation at atmospheric pressure, 760 mm. — First drop 30 C (86 F)

Fraction no.	Cut at C	Cut at F	Per cent	Sum, per cent	Sp. gr. 60/60 F	°API 60 F	C. I.	S.U. visc., 100 F	Cloud test, F	Aniline point, C
1	50	122	1.2	1.2	0.660	82.9				
2	75	167	1.4	2.6	0.664	81.6	4.6			
3	100	212	2.9	5.5	0.686	74.8	5.2			
4	125	257	3.4	8.9	0.719	65.3	12			
5	150	302	4.8	13.7	0.746	58.2	17			
6	175	347	4.4	18.1	0.767	53.0	20			
7	200	392	4.0	22.1	0.784	49.0	22			
8	225	437	4.1	26.2	0.806	44.1	27			59.2
9	250	482	5.1	31.3	0.823	40.4	30			62.8
10	275	527	6.7	38.0	0.843	36.3	34			64.0
Distillation continued at 40 mm.										
11	200	392	2.3	40.3	0.873	30.6	45	42	Below 5	66.4
12	225	437	6.2	46.5	0.878	29.7	43	48	15	
13	250	482	6.4	52.9	0.895	26.6	48	63	35	
14	275	527	5.7	58.6	0.911	23.8	52	100	50	
15	300	572	7.7	66.3	0.932	20.3	59	220	70	
Residuum			31.8	98.1	1.007	..				

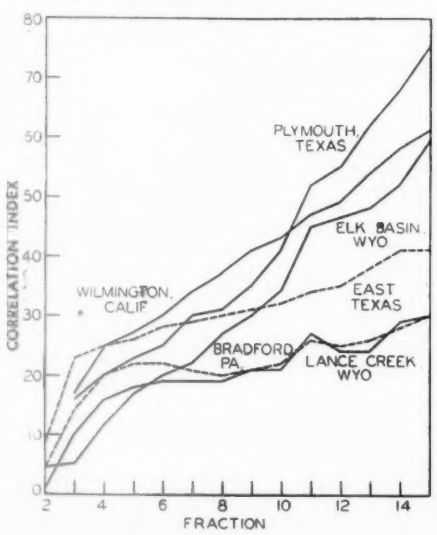
Carbon residue of residuum, 16.7 per cent; carbon residue of crude, 6.1 per cent.

Approximate Summary.

Light gasoline	Per cent 5.5	Sp. gr. 0.675	°API 78.1	Viscosity
Total gasoline and naphtha	22.1	0.735	61.0	
Kerosine distillate	9.2	0.815	42.1	
Gas oil	13.2	0.859	33.2	
Nonviscous lubricating distillate	11.2	0.881–0.911	29.1–23.8	50–100
Medium lubricating distillate	5.5	0.911–0.928	23.8–21.0	100–200
Viscous lubricating distillate	5.1	0.928–0.944	21.0–18.4	Above 200
Residuum	31.8	1.007	....	
Distillation loss	1.9			

paraffin wax. The Elk Basin field was the second largest producer in the State in 1947, and ranks sixth in total production. The Madison limestone in Elk Basin has been opened only recently to production, but it is expected to produce a large quantity of oil. This oil is a typical "black oil" with a high sulphur content, containing little paraffinic wax. The particular analysis shown was of oil obtained from a well in the north end of the field in Montana.

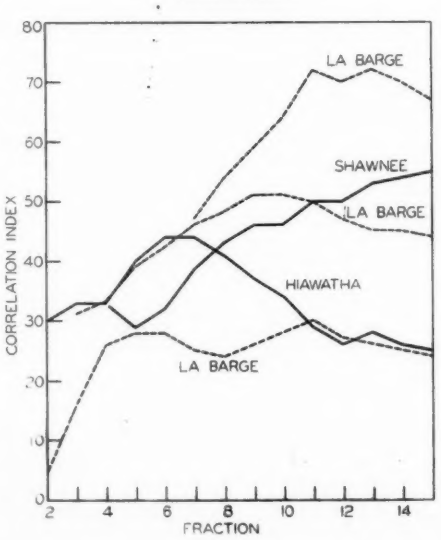
FIG. 2. Correlation indices of fractions from representative crude oils.



The correlation index[5] is an empirical value derived from the average boiling point and specific gravity of a petroleum fraction. It is so derived that normal paraffins have a value of 0 while benzene has a value of 100. Crude oils whose fractions have relatively low correlation indices are paraffinic, while those with fractions having high values are naphthenic or even aromatic. The correlation index is also used as a means of comparing oils as to origin. Oils from the same formation generally show similar correlation-index patterns. Fig. 2 shows the correlation indices of the above two Wyoming crude oils compared with those of crude oils from various sections of the country. It will be noted that the Lance Creek oil is as paraffinic as Bradford, Pennsylvania crude oil, while the Elk Basin oil is naphthenic like the California and Gulf Coast oils.

Crawford and Larsen[1] have capably classified Rocky Mountain oils into six major and four intermediate types based on correlation-index studies. However, they stated that four-fifths of the oils studied fell into one of two major types or into an intermediate between the two. These major types

FIG. 3. Correlation indices of fractions from Oligocene and Eocene epoch formations.



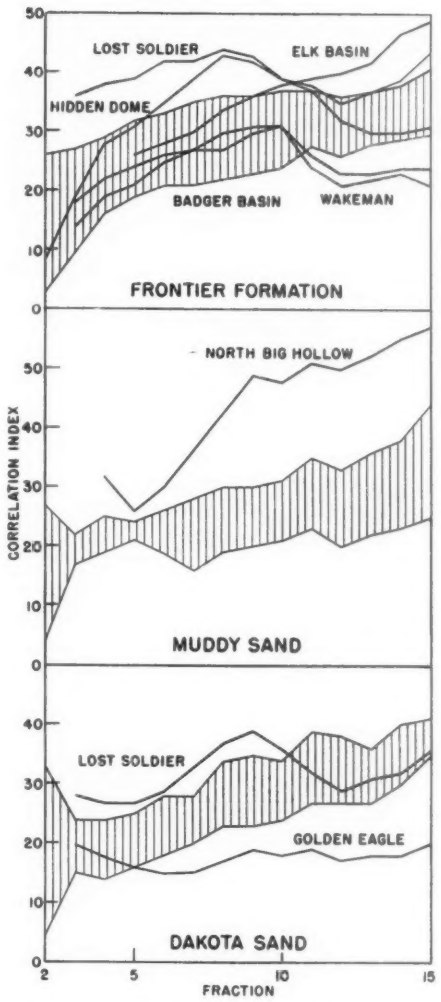


FIG. 4. Correlation indices of fractions from crude oils produced from Upper Cretaceous period formations.

correspond roughly to the "green"- and "black"-oil classification. Exceptions to the usual patterns often can be explained on the basis of local geologic conditions.

Data on Wyoming Crude Oils. Crude-oil analyses of 104 samples from 67 fields of Wyoming were given in Bulletin 418.[3] One hundred and forty crude oils from 91 fields are listed in the tables of the present report. Most of the additional oils represent new production developed since completion of the bulletin 10 years ago. In this report the discussion of the oils will be by reference to the geologic time of the formation from which they were produced.

Oligocene- and Eocene-epoch oils. Only a few oils have been produced from formations of Oligocene or Eocene epoch. Properties of five of these oils are shown in Table 3. They range in gravity from 23-46 API, have 0.2 or less per cent sulphur, have widely varying pour points and gasoline yields, and have low carbon residues. The correlation indices of these oils are plotted in Fig. 3. The one oil from an Oligocene formation (White River) at Shawnee shows steadily decreasing paraffinicity (increasing correlation index) with increasing boiling point. Each of the other oils exhibits a break in the curve showing the higher boiling fractions to be more paraffinic than some of the intermediate fractions.

Upper Cretaceous period oils. The properties of crude oils produced from formations of Upper Cretaceous period are shown in Table 4. Most of the oils in this group come from the Frontier, the Muddy, and the Dakota sandstones. Typical oils from the Frontier formation have gravities ranging from 30-50 API, have sulphur contents below 0.1 per cent, and have low pour points and carbon residues. Certain exceptions, such as the oil in the Frontier formation in the Elk Basin and Bison Basin fields, will be noted. Typical oils from the Muddy sand of the Thermopolis shale also show low sulphur contents but have somewhat higher pour points. Dakota sandstone oils have gravities ranging from 28-52 API, sulphur contents up to 0.36 per cent, varying pour points, and generally give smaller gasoline yields.

Correlation indices are shown in Fig. 4, where the cross-hatched areas indicate the spread for most of the oils. The exceptions are shown indi-

TABLE 3. Comparison of Wyoming crude oils produced from formations of Oligocene and Eocene epochs.

Formation	Field	County	Approx. depth, ft	Gravity, °API	Sulphur, wt per cent	Pour point, F	Carbon residue, wt per cent	Gasoline, per cent	Residuum, per cent
White River	Shawnee area	Converse	558-561	24.8	0.14	below 5	0.8	7.0	30.9
Wasatch	Hiawatha	Moffat[1]	2020-2220	35.0	0.21	75	1.2	19.8	18.9
Almy	Labarge	Sublette	1231-1292	45.8	0.20	65	0.3	41.2	9.1
	Labarge	Lincoln	787-817	32.5	below 0.1	35	0.6	20.1	17.2
	Labarge	Lincoln	800-1000	22.5	0.14	below 5	1.4	3.5	26.0

[1]Sample taken in Colorado; field in Moffat County, Colo., and Sweetwater County, Wyo.

TABLE 4. Comparison of Wyoming crude oils produced from formations of Upper Cretaceous period.

Formation	Field	County	Approx. depth, ft	Gravity, °API	Sulphur, wt per cent	Pour point, F	Carbon residue, wt per cent	Gasoline, per cent	Residuum, per cent
Mesaverde fm.[1]	Simpson Ridge	Carbon	635	22.1	0.15	below 5	2.3	2.1	33.7
Steele sh.[2]	Big Muddy	Converse	1000-1150	32.8	0.25	....	1.7	24.4	31.1
[2]	East Teapot	Natrona	825-975	35.6	below 0.1	30	0.99	24.1	26.1
[3]	G. P.	Carbon	3116-3131	31.5	0.22	40	1.4	22.9	25.2
	Pilot Butte	Fremont	950	38.8	below 0.1	below 0	1.0	34.5	18.8
Carlile sh.	Thornton	Weston	707-737	40.6	below 0.1	....	....	....	24.0
Frontier fm.	Badger Basin	Park	8250-8591	48.7	below 0.1	below 0	0.31	50.8	7.3
[4]	Big Muddy	Converse	3069-3180	35.6	0.10	50	1.6	25.3	29.5
	Bison Basin	Fremont	1221-1328	16.2	0.45	below 5	3.9	0	42.2
[5]	Cole Creek	Natrona	6740	28.9	0.22	45	4.6	19.0	33.6
[7]	Elk Basin	Park	1828-1846	38.4	0.95	below 5	2.6	46.8	17.7
	Garland	Park	450-700	40.6	below 0.1	below 5	0.16	43.4	10.8
[7]	Grass Creek	Hot Springs	775-1110	45.8	below 0.1	0	.4	48.8	10.6
	Hidden Dome	Washakie	1538-1543	43.6	below 0.1	below 0	0.1	57.8	1.6
	Kirby Creek	Hot Springs	405	40.0	below 0.1	below 0	0.8	36.8	17.8
[6]	Lost Soldier	Sweetwater	373-604	30.4	0.11	below 5	1.4	14.6	22.2
[6]	Midway	Natrona	5193	32.1	0.23	75	3.0	19.0	39.6
[6]	Naval Reserve No. 3 (Teapot)	Natrona	....	35.4	0.20	50	1.7	28.0	27.2
[5]	Salt Creek	Natrona	1370-1420	37.4	below 0.1	25	1.6	28.5	27.8
	South Sand Creek	Washakie	6710-6892	43.4	below 0.1	20	0.2	40.9	13.7
[5]	Wakeman	Crook	610	39.0	0.10	below 10	1.0	31.6	22.3
	West Poison Spider	Natrona	14190-14309	41.5	below 0.1	below 5	0.4	38.1	16.2
Mancos sh.	Pilot Butte	Fremont	....	35.4	0.22	....	1.2	24.0	21.4
Mowry sh.	Plunkett	Fremont	220	40.9	0.12	below 5	0.2	35.9	13.0
	Torchlight	Big Horn	450-700	46.3	....	....	....	42.0	31.5
Thermopolis sh.[8]	Alkali Butte	Fremont	3960-3970	34.1	below 0.1	....	....	....	....
[8]	Ant Hills	Niobrara	3951-3958	28.7	0.14	95	2.8	2.4	42.9
[8]	Buck Creek	Niobrara	4212-4230	32.7	below 0.1	55	1.7	16.3	31.5
[8]	Dutton Creek	Carbon	4876-4905	33.4	0.26	50	3.7	27.6	28.8
[8]	Golden Eagle	Hot Springs	6720-6776	62.6	below 0.1	below 5	....	86.3	3.0
[8]	North Big Hollow	Albany	880-925	18.7	0.51	below 5	6.2	6.1	47.1
[8]	Rex Lake	Albany	3786-3810	35.2	0.15	50	2.2	26.7	29.5
[8]	Shoshone	Park	1083-1098	41.9	below 0.1	10	0.3	40.6	17.2
Graneros sh.[9]	Mush Creek	Weston	4167-4215	42.8	0.1	below 5	0.4	36.8	17.0
[9]	Osage	Weston	1125	37.6	below 0.1	below 5	1.0	36.4	18.6
	Pedro	Weston	270	29.5	0.22	below 5	2.3	9.8	38.5
Aspen fm.	Spring Valley	Uinta	700-1200	39.0	0.1	15	0.6	29.9	15.5
Bear River fm.	Aspen	Uinta	911	22.1	0.25	below 5	7.1	6.0	51.8
Dakota ss.	Big Muddy	Converse	4298-4312	36.8	0.12	60	1.9	26.7	26.4
	Golden Eagle	Hot Springs	7379	51.8	below 0.1	....	0.1	54.3	5.6
	Iron Creek	Natrona	800-825	28.0	0.21	20	2.2	6.6	52.8
	Lance Creek	Niobrara	3495-3511	40.2	below 0.1	below 5	0.3	35.3	16.8
	Lost Soldier	Sweetwater	2098-2128	31.1	below 0.1	75	1.7	13.1	25.6
	North Geary	Natrona	6365-6383	28.0	0.36	75	4.1	12.0	42.6
	Quealy Dome	Albany	3369-3401	33.2	0.27	15	2.6	24.8	28.1
	Rex Lake	Albany	4050	32.7	0.19	50	2.8	23.0	33.4
	Rock River	Albany	3447-3462	37.4	0.13	35	2.2	30.1	23.2
	West Mule Creek	Niobrara	220-240	34.6	0.13	10	1.1	17.7	26.3

[1]Quealy sand.
[2]Shannon sand.
[3]G. P. sand.
[4]Wall Creek sand.
[5]First Wall Creek sand.
[6]Second Wall Creek sand.
[7]Peay ss.
[8]Muddy sand.
[9]Newcastle sand.

TABLE 5. Comparison of Wyoming crude oils produced from formations of Lower Cretaceous period.

Formation	Field	County	Approx. depth, ft	Gravity, °API	Sulphur, wt per cent	Pour point, F	Carbon residue, wt per cent	Gasoline, per cent	Residuum, per cent
Cloverly[1]	Big Muddy	Converse	4362-4406	31.3	0.15	55	3.9	22.2	32.5
[1]	Cole Creek	Natrona	7974-8013	35.0	0.19	45	3.2	27.9	28.4
[2]	Greybull	Big Horn	1115-1265	48.5	below 0.1	50	0.2	45.1	11.1
[1]	Horse Creek	Laramie	5449-5515	30.2	0.35	....	2.3	15.5	29.4
[1]	Lost Soldier	Sweetwater	1897-1950	29.7	0.10	75	1.7	8.2	23.4
[1]	Mule Creek	Niobrara	1355	31.5	0.12	60	0.9	13.1	34.4
[1]	Salt Creek	Natrona	2340-2390	36.9	0.12	55	2.8	28.1	31.0
[1]	Sussex	Johnson	7698-7726	39.2	0.35	30	1.7	30.3	23.7

[1]Lakota sand. [2]Greybull sand.

TABLE 6. Comparison of Wyoming crude oils produced from formations of Jurassic and Triassic periods.

Formation	Field	County	Approx. depth, ft	Gravity, °API	Sulphur, wt per cent	Pour point, F	Carbon residue, wt per cent	Gasoline, per cent	Residuum, per cent
Morrison fm.	Lost Soldier	Sweetwater	1950-1954	28.7	0.11	75	2.0	4.7	27.8
Sundance fm.	Bolton Creek	Natrona	1100	21.6	2.31	below 5	10.2	10.2	43.6
	Dewey Dome	Weston	988-1017	25.4	0.88	below 5	5.0	8.5	25.0
[1]	Lance Creek	Niobrara	3854-3907	49.4	below 0.1	below 5	0.4	46.2	8.8
	Lost Soldier	Sweetwater	1975-2068	29.5	0.10	75	1.9	11.4	27.3
[2]	Medicine Bow	Carbon	5299-5397	62.9	below 0.1	below 5	0.1	70.2	0.9
	Poison Spider	Natrona	1400-1600	19.5	3.13	below 5	10.3	11.5	43.8
	Quealy Dome	Albany	3670-3728	33.6	0.28	55	3.2	25.4	30.4
	Rock River	Carbon	3164-3188	36.0	0.16	20	2.1	31.4	23.8
[3]	Salt Creek	Natrona	2915-2921	36.0	0.27	65	2.5	26.9	29.0
	Spindletop	Natrona	1057	21.0	3.30	15	8.6	8.6	46.7
	Steamboat Butte	Fremont	5092-5272	28.2	2.41	....	6.4	22.6	31.3
Chugwater fm.[4]	Hamilton Dome	Hot Springs	1745-1760	21.0	3.05	below 5	9.5	11.1	43.8

[1]From Basal Sundance sand. [2]From Second Sundance sand. [3]From Third Sundance sand. [4]Curtis ss.

TABLE 7. Comparison of Wyoming crude oils produced from formations of Permian epoch.

Formation	Field	County	Approx. depth, ft	Gravity, °API	Sulphur, wt per cent	Pour point, F	Carbon residue, wt per cent	Gasoline, per cent	Residuum, per cent
Embar fm.	Bolton Creek	Natrona	2000	31.5	2.87	below 5	5.7	25.4	30.0
	Byron	Big Horn	5252-5366	19.5	2.97	below 5	10.3	10.9	50.3
	Circle Ridge	Fremont	230	23.7	2.84	....	5.8	11.0	38.7
	Dallas Dome	Fremont	900-1100	21.3	2.89	below 5	8.0	9.3	39.5
	Gebo	Hot Springs	4535-4650	29.5	2.04	....	4.4	16.0	30.3
	Grass Creek	Hot Springs	3962-3980	24.5	2.54	below 5	3.8	16.1	45.0
	Hamilton Dome	Hot Springs	2462-2488	25.6	2.39	below 5	6.8	17.9	35.3
	Hamilton Dome	Hot Springs	2863-2889	16.7	3.49	15	10.5	5.3	53.1
	Lake Creek	Hot Springs	3705-3720	22.3	3.17	below 5	6.8	15.5	37.3
	Lander	Fremont	1800	24.0	2.98	below 5	6.2	11.0	39.2
	Maverick Springs	Fremont	1634-1649	21.8	2.91	below 5	6.8	8.5	40.3
	Muskrat	Fremont	7268-7286	30.0	2.27	30	4.3	22.1	28.2
	Neiber	Washakie	10025-11000	40.6	1.88	below 5	0.8	54.6	6.8
	Oregon Basin	Park	3508-3636	20.8	3.28	below 5	9.7	16.1	45.2
	Pilot Butte	Fremont	6150-6210	24.0	2.35	....	6.5	14.4	27.4
	River Dome	Washakie	10268-10720	34.2	1.91	below 5	1.8	31.8	19.4
	Sheep Creek	Fremont	2002-2011	23.1	2.78	below 5	9.1	13.9	38.9
	Sheldon	Fremont	6545	35.0	0.95	below 5	2.4	27.6	22.2
	Shoshone	Park	4309-4540	21.1	3.20	5	7.4	14.7	44.0
	South Fork	Washakie	10055-10900	28.2	1.91	below 5	6.1	16.3	36.1
	Sunshine	Park	2480-2514	17.9	3.15	10	10.5	6.2	46.8
	Wagonhound	Hot Springs	4278-4302	28.6	1.38	below 5	5.4	20.3	31.9
	Warm Springs	Hot Springs	1000	22.0	3.16	below 5	8.5	12.2	34.8
	Waugh	Hot Springs	3690-3807	27.8	1.77	below 5	6.4	19.9	31.5

vidually. The typical oil for all of the several sands of Upper Cretaceous period is paraffinic in the low-boiling fractions but shows increasing correlation index as the boiling point increases. Oils from Lost Soldier, Hidden Dome, Badger Basin, and Wakeman show maxima in their curves similar to those for Eocene oils. Elk Basin and North Big Hollow oils are more naphthenic in the high boiling fractions, resembling the black oils. Golden Eagle oil has almost a constant correlation index, giving a straight-line plot and showing high paraffinicity.

Lower Cretaceous period oils. The chief oil production is from the Lakota sandstone of the Cloverly formation. The properties of Lower Cretaceous oils are given in Table 5. These oils have gravities from 30-50 API, sulphur contents varying up to 0.35 per cent, high pour points, and low carbon residues. The correlation indices (Fig. 5) indicate them to be paraffinic but with increasing correlation indices. The Lost Soldier oil is again an exception, showing a maximum in the curve, while the Greybull and Mule Creek oils yield relatively flat curves.

Jurassic- and Triassic-period oils. The principal oil-productive formation among rocks of these periods is the Sundance formation of the Jurassic. Two quite different types of oil are produced from this formation. One is a light gravity, low sulphur, low carbon residue, paraffinic oil while the other is a typical black oil with high sulphur and low gasoline content. Properties of these oils are shown in Table 6, and the correlation indices are indicated in Fig. 6. The Lost Soldier oil again shows the type of curve containing a maximum. The Curtis sandstone oil from Hamilton Dome gives a somewhat steeper curve but is similar to the Sundance oils.

Permian-epoch oils. The Embar limestone is an important producing formation in Wyoming. Properties of Embar oils from 24 fields are listed in Table 7. Embar oils are typical black oils. Their gravities are generally in the range of 20-30 API. The sulphur contents are high and are closely proportional to the gravity (Fig. 7), as are those of oils from older formations. The pour points and the gasoline yields are low. Carbon residues are high, indicating the oil to be asphaltic. Correlation indices (Fig. 8) show the oils to be paraffinic in the low boiling

FIG. 5. Correlation indices of fractions from crude oils produced from Lower Cretaceous period formations.

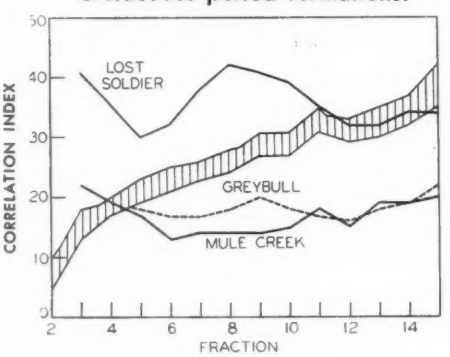
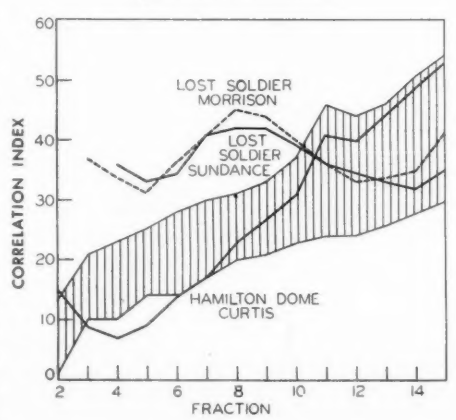


FIG. 6. Correlation indices of fractions produced from Jurassic and Triassic period formations.



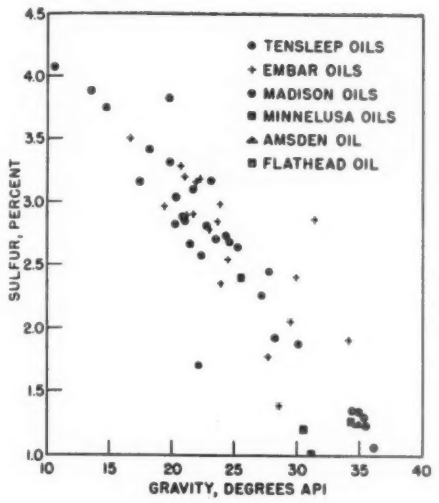


FIG. 7. Relation between sulphur content and gravities of oils from Permian, Pennsylvanian, Mississippian, and Cambrian formations.

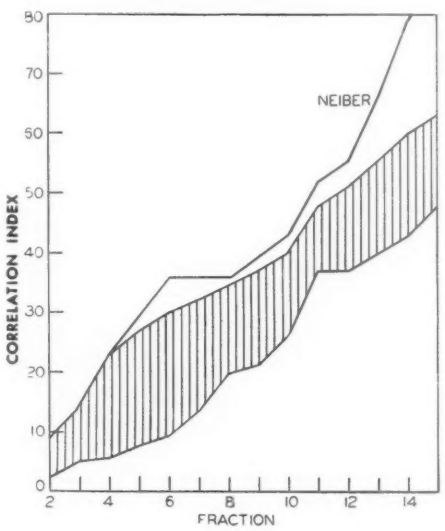


FIG. 8. Correlation indices of fractions from crude oils produced from Permian epoch formations.

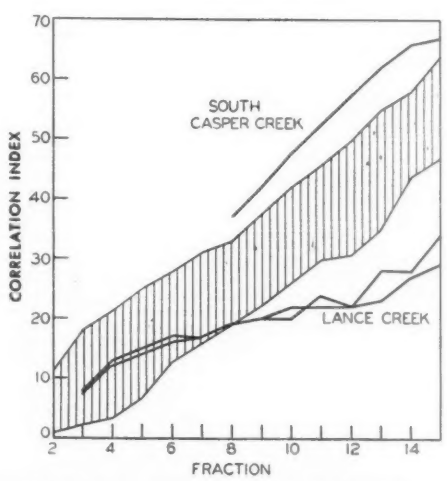


FIG. 9. Correlation indices of fractions from crude oils produced from Pennsylvanian epoch formations.

fractions and naphthenic in the high-boiling fractions.

Pennsylvanian-epoch oils. The Tensleep sandstone and its equivalent, Minnelusa sandstone, are the principal producing formations. Black oils very similar to the Embar oils are produced from the Tensleep, Minnelusa, and Amsden formations (see Table 8 and Figs. 7 and 9). The Minnelusa sandstone produces black oil in the Adon, Mule Creek, and West Mule Creek fields; but in the Lance Creek field a green oil of 40-42 API gravity and low sulphur content is produced (Table 8). The latter oil is paraffinic, having a pour point of 25-60 F, and is greatly different in character from the other Minnelusa oils (Fig. 9).

Mississippian-epoch oils. The Madison limestone produces a heavy black oil similar in most respects to the heavier oils from the Embar limestone and Tensleep sandstone. Properties of Madison oils are shown in Table 9 and Figs. 7 and 10. The correlation-index curves are somewhat steeper than those for the Embar or Tensleep oils.

Cambrian-period oils. The only oil produced from formations of the Cambrian period is that from the Flathead formation in the Lost Soldier field. Properties of this oil, as shown in Table 9, indicate it to be similar to other black oils produced from formations of Permian, Pennsylvanian, and Mississippian epochs.

▸ **Additional discussion.** The unusual characteristics of several oils that were listed earlier in the report warrant further discussion. In Fig. 3 is shown the correlation-index pattern for oil from the White River formation of Oligocene epoch at Shawnee. This oil does not have the characteristics of other Tertiary-period oils but does have the character of oils from formations of Pennsylvania or Mississippian epochs. Consequently, in view of geological concepts regarding structure in this area, it can be assumed logically that the oil migrated from the Tensleep sandstone or the Madison limestone, rising out of the Powder River Basin into the relatively flat overlying White River formation.

TABLE 8. Comparison of Wyoming crude oils produced from formations of Pennsylvanian epoch.

Formation	Field	County	Approx. depth, ft	Gravity, °API	Sulphur, wt per cent	Pour point, F	Carbon residue, wt per cent	Gasoline, per cent	Residuum, per cent
Tensleep	Black Mountain	Hot Springs	3125	22.8	2.82	below 5	6.6	12.0	44.1
	Circle Ridge	Fremont	680	24.2	2.73	....	6.7	15.1	32.0
	Crystal Creek	Big Horn	963-983	19.8	3.82	below 5	8.9	8.6	47.7
	Derby Dome	Fremont	1266-1326	22.3	2.57	below 5	7.1	11.2	39.0
	Dewey Anticline	Weston	2300-2305	36.0	1.06	below 5	2.4	39.7	16.2
	Elk Basin	Park	5195-5384	30.0	1.87	below 5	4.0	27.9	29.9
	Fourbear	Park	3260-3278	13.5	3.88	45	13.3	2.3	55.9
	Frannie	Park	2600-2825	27.7	2.44	below 5	4.6	22.4	32.3
	Garland	Park	4235-4323	21.0	2.84	below 5	8.9	9.7	38.3
	Gebo	Hot Springs	4880-5103	23.5	2.71	....	5.5	13.0	39.7
	Grass Creek	Hot Springs	3992	25.2	2.64	below 5	7.0	16.4	37.6
	Lander	Fremont	1715-1840	23.3	2.85	below 5	6.1	9.6	38.6
	Little Buffalo Basin	Park	4780-4965	19.8	3.31	below 5	9.4	14.3	45.9
	Lost Soldier	Sweetwater	3942-4009	34.2	1.23	below 5	3.2	30.2	23.3
	Mahoney Dome	Carbon	4233-4486	34.2	1.25	below 5	2.9	27.0	22.4
	Maverick Springs	Fremont	1650	21.8	2.88	below 5	7.3	8.0	43.5
	North Casper Creek	Natrona	3300	20.2	2.82	15	9.1	7.2	42.8
	North Sunshine	Park	3486-3632	14.7	3.74	35	11.6	5.3	55.5
	Notches Dome	Natrona	2754-2797	22.0	1.70	below 5	7.1	7.1	40.2
	Pilot Butte	Fremont	6159-6418	24.5	2.68	....	7.3	15.9	38.5
	Quealy	Albany	5480-5600	21.6	3.11	....	10.3	19.8	39.5
	Salt Creek	Natrona	3775-3802	27.0	2.25	below 5	6.2	14.9	37.1
	Sand Draw	Fremont	7281-7593	34.2	1.35	below 5	3.1	26.6	21.8
	South Casper Creek	Natrona	2400-2600	15.3	4.49	below 5	10.7	7.0	44.2
	Steamboat Butte	Fremont	6760-7023	28.7	2.10	below 5	5.3	19.4	33.8
	Wertz	Carbon	5872-5886	35.2	1.30	below 5	2.5	30.8	23.5
	Winkleman Dome	Fremont	2915-3534	23.1	3.17	below 5	7.2	14.6	41.8
Minnelusa ss.	Adon	Campbell	8990-9945	30.6	1.20	below 5	4.5	15.8	31.9
	Mule Creek	Niobrara	3145-3184	25.6	2.40	below 5	4.8	21.4	29.7
	West Mule Creek	Niobrara	2820-2830	31.1	1.01	below 5	1.5	29.5	22.9
[1]	Lance Creek	Niobrara	4394-4434	41.5	below 0.1	65	1.1	35.2	20.5
[2]	Lance Creek	Niobrara	5344-5404	43.2	below 0.1	40	1.0	36.0	19.2
Amsden	Wertz	Sweetwater	6494-6587	35.0	1.25	below 5	2.6	28.2	23.2

[1]Converse sand. [2]Leo sand.

TABLE 9. Comparison of Wyoming crude oils produced from formations of the Mississippian epoch and Cambrian period.

Formation	Field	County	Approx. depth, ft	Gravity, °API	Sulphur, wt per cent	Pour point, F	Carbon residue, wt per cent	Gasoline, per cent	Residuum, per cent
Madison	Elk Basin	Carbon[1]	4838-5797	28.4	1.92	below 5	6.1	22.1	31.8
	Frannie	Park	2925-3013	17.6	3.16	below 5	9.1	3.5	49.5
	Garland	Big Horn	3994-4100	20.5	3.03	below 5	9.9	12.7	42.2
	Lost Soldier	Sweetwater	4794-5410	35.6	1.22	below 5	3.0	28.6	24.1
	Oregon Basin	Park	4619-4672	18.2	3.41	below 5	9.6	9.2	54.3
	Red Springs	Hot Springs	902-1082	10.7	4.08	45	13.0	0.7	56.7
	Salt Creek	Natrona	4375	21.6	2.66	45	10.9	8.2	43.6
	Wertz	Sweetwater	6762-7193	35.0	1.34	below 5	2.8	28.5	22.6
Flathead ss.	Lost Soldier	Sweetwater	5964-6288	34.6	1.27	below 5	3.3	28.5	24.7

[1]Field in Carbon County, Mont., and Park County, Wyo.

TABLE 10. Some properties of crude oils produced from the Lost Soldier field.

Formation	Depth, ft	Gravity, °API	Sulphur, wt per cent	Pour point, F	Carbon residue wt per cent	Gasoline, per cent	Residuum, per cent
Second Wall Creek	373-604	30.4	0.11	below 5	1.4	14.6	22.2
Dakota	2098-2128	31.1	below 0.1	75	1.7	13.1	25.6
Lakota	1897-1950	29.7	0.1	75	1.7	8.2	23.4
Morrison	1950-1954	28.7	0.11	75	2.0	4.7	27.8
Sundance	1975-2068	29.5	0.10	75	1.9	11.4	27.3
Tensleep	3942-4009	34.2	1.23	below 5	3.2	30.2	23.3
Madison	4794-5410	35.6	1.22	below 5	3.0	28.6	24.1
Flathead	5964-6288	34.6	1.27	below 5	3.3	28.5	24.7

Some comments were made previously regarding the oils in the Lost Soldier field. Recent discovery of production in the Flathead formation (Cambrian) opened the 13th producing zone. The 13 zones include 5 Wall Creek sands, and the Muddy, the Dakota, the Lakota, the Morrison, the Sundance, the Tensleep, the Madison, and the Flathead formations. Table 10 shows some of the properties of 8 of these oils. The character of the oil changes markedly below the Sundance to give a "black oil." The correlation-index patterns of these eight oils indicate that the oils in all zones through the Sundance formation are of the same type. In the light of the faulted nature of the Lost Soldier structure, it is quite conceivable that the oils found in the 8 zones above the Tensleep originally came from the same source. A very different type of oil was found in the 3 productive formations of the Tensleep, Madison, and Flathead. This type can be considered normal for oils from formations of these geologic times. Further conjecture would suggest that the faults which provided for filling the upper sands in the structure ran out or discontinued somewhere in the "red beds" of the thick Chugwater formation between the Sundance and the Tensleep formations. Certainly comparison of the characteristics of the oils below the red beds with those of the oils above the red beds, as portrayed by the correlation-index patterns, reveals no intermingling of these oils.

The oil found in the Minnelusa sandstone of the Adon field is a "black oil" similar to that found at Mule Creek and similar to Tensleep oils in general. This emphasizes the remarkable deviation from pattern by which a "green oil" is produced from the Minnelusa sandstone at Lance Creek. Comparison of the correlation-index patterns of the oils produced from the Dakota, First Sundance, Basal Sundance, Converse, and Leo sands in the Lance Creek field reveals that the Dakota sandstone oil is somewhat different from the oils found in other sands. The oils from the Sundance and the Minnelusa sands are of the same type —not the typical "black oil" of Pennsylvanian and Mississippian ages but

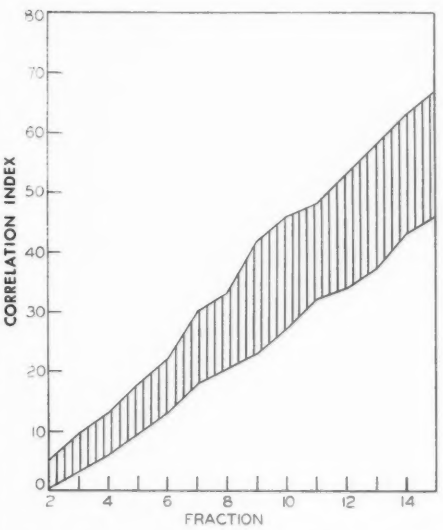


FIG. 10. Correlation indices of fractions from crude oils produced from Mississippian epoch and Cambrian period formations.

TABLE 11. Partial list of fields and formations in which new oils were discovered.

Field	Formation	Year discovered
Adon	Minnelusa	1948
Elk Basin	Madison	1946
Lost Soldier	Madison	1947
Lost Soldier	Flathead	1948
Mush Creek	Newcastle	1944
Neiber	Embar	1947
River Dome	Embar	1946
Sand Draw	Tensleep	1944
Sheldon	Embar	1945
South Elk Basin	Tensleep	1945
South Fork	Embar	1947
South Sand Creek	Frontier	1947
Steamboat Butte	Tensleep	1944
Sussex	Lakota	1948
Wertz	Amsden	1948
Wertz	Madison	1948
West Poison Spider	Frontier	1948

a "green oil" of Jurassic age. Present knowledge of the structural geology at Lance Creek indicates that formations rising from the Powder River Basin come in contact with a major fault zone on the north side of the Lance Creek structure and that the Lance Creek structure is on the upthrown, overthrust side. This information, in conjunction with the data on the characteristics of the oils, suggests that the Minnelusa sandstone oils did not originate in or near that formation but escaped from younger, though deeper, formations through the fault zone into the Minnelusa sandstone trap.

Some of the new oils found in Wyoming during the past several years, the data from the analyses of which are included in this paper, are listed in Table 11. Included is the oil obtained from the well having, so far as is known, the world's greatest oil producing depth (West Poison Spider). Also included is the oil obtained from the first well in Wyoming to produce commercially from a formation older than the Mississippian (Lost Soldier).

Most of these oils are from formations of Permian or older time. These oils of Permian and older time conform very closely to previously established patterns of characteristics. Many of the recent discoveries are from greater depths than those previously found. These oils often have lighter gravities and, with such gravities, lower sulphur content. In view of the characteristic correlation-index pattern for such oils, it is possible to make a fairly certain prediction as to the character of a new oil apt to be produced from formations of Permian or older time. One exception—that of the oil from the Embar limestone at Neiber Dome—can be cited. This oil is somewhat more naphthenic than other oils from the Embar. Attending circumstances, not completely understood as yet but relating to the presence of hydrogen sulfide, may cause this exception.

Acknowledgments. This report represents the results of work done under a cooperative agreement between the Bureau of Mines, United States Department of the Interior, and the University of Wyoming. Acknowledgments are due O. C. Baptist for collecting samples of oil, to W. J. Wenger and Mrs. R. L. Hubbard for making some of the analyses, and to R. E. Skochdopole for some of the compilations. The report was made under the general supervision of R. A. Cattell, Chief, Petroleum and Natural Gas Branch, and H. P. Rue, Supervising Engineer, Petroleum and Oil-Shale Experiment Station, Laramie, Wyoming.

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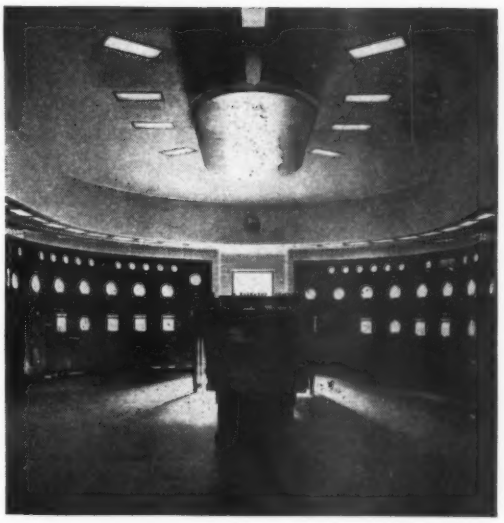

THE basic step in all refinery expansion or modernization is, of course, process engineering. And it is in this first step that the so-called "master" type of contract – under which one engineering company takes complete responsibility for all work at any particular job site – starts paying dividends to any refiner.

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With regard to the first of these advantages, a simple review of what goes on under alternate methods of placing contracts appears to offer sufficient proof. For example, a refiner's engineering staff must originally decide on the general plan for any expansion or modernization—based on its own intimate knowledge of the company's current situation and its future marketing plans.

To do this, even the largest companies customarily call in outside engineering counsel. For, with very few exceptions, refiners cannot afford to maintain specialists in every refining step devoting themselves to a particular process on a full-time basis. Since the advisory engineers called in usually work for companies whose business is building refineries—and since they quite naturally desire their company to get the lion's share of the forthcoming order—a "promotion" of varying processes and methods usually ensues.

As a result, instead of being faced with the calm evaluation of engineering principles and the comparative economics of alternative processing plans, the refiner's staff becomes involved in refereeing the claims of rival engineering experts—arriving, all too often, at a processing sequence that represents a compromise of conflicting opinions.

By contrast, the "master" contract method of operation is simplicity itself. One engineering contractor—*who can afford to* and *does* employ full-time specialists in every phase of processing—provides the refiner's staff with as many alternate processing sequences as are desired. Each of these plans is fully integrated—with all engineering factors included and balanced. Thus the *refiner's* staff can concentrate on its most important function—the expeditious evaluation of alternate processing plans *on the basis of economics*, including product yields and qualities, operating costs, maintenance costs, marketing requirements and crude supply, both present and future.

by
LUTHER HILL
In Charge of
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The second stated advantage is a natural outgrowth of the first. It is safe to say that just two of the many "plus" factors present under the "master" contract operation would justify its adoption—namely (1) the uniformity of processing tolerances in all units embraced in the overall plan and (2) the saving in engineering man-hours generally wasted under alternative methods in checking processing details between the refiner and several engineering contractors and vice versa.

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There are, of course, many other advantages of integrated process planning by one company which can be discerned in the centralization of controls, the integration of heat balances and efficiencies, and the steps taken to insure continuity of processing.

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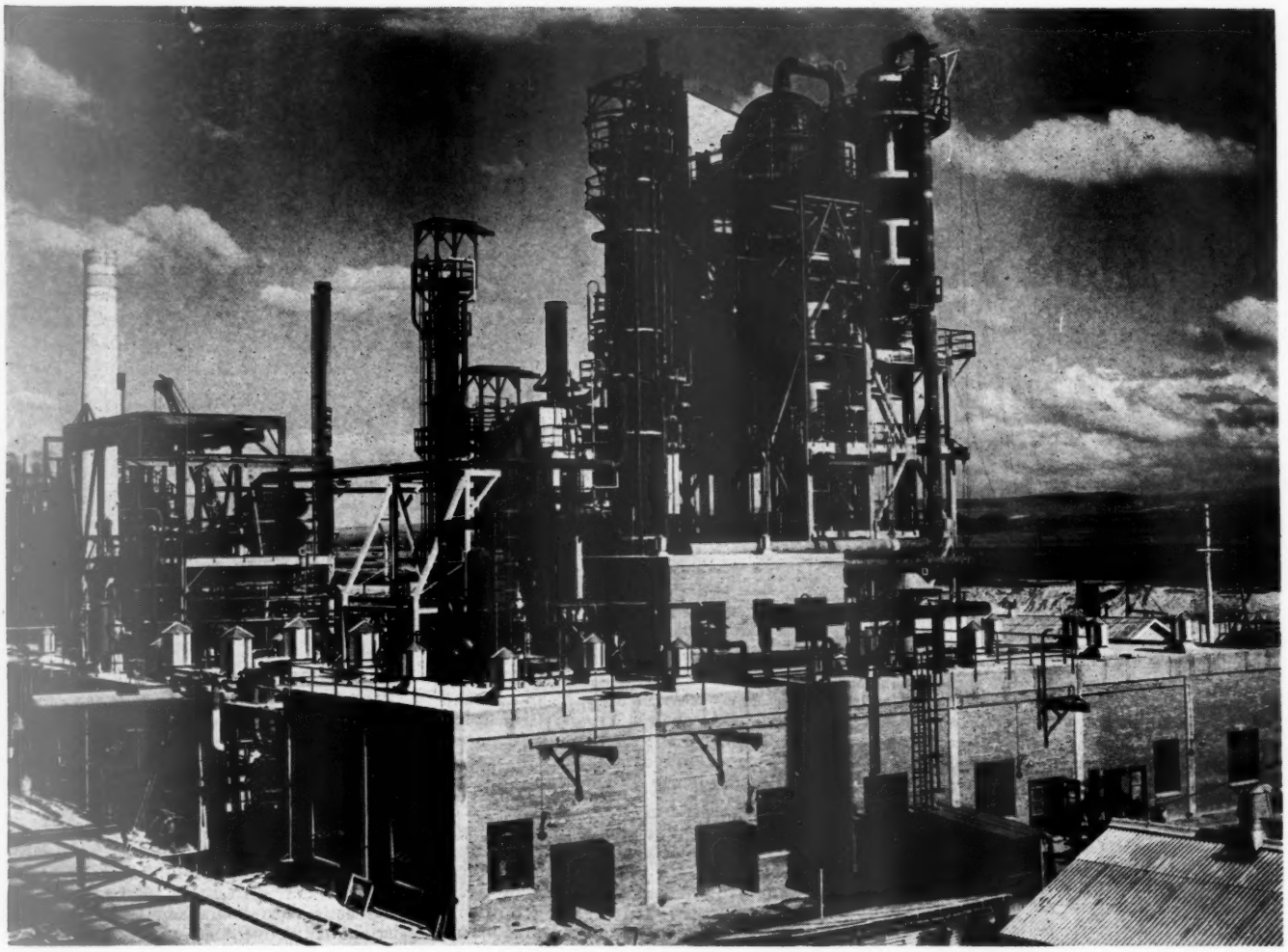

FIG. 1. The Texas Company's Casper, Wyoming, fluid catalytic cracking unit, with fractionator equipment in the middle ground, pump and control house in foreground, and main unit in background.

Texaco Plant Typical of Wyoming's Best

By ARCH L. FOSTER, *Refining Editor*

TYPICAL of the best of the refining capacity installed in Wyoming's 22 refineries is that of The Texas Company at Casper, third largest of the state's plants. Rated at 12,000 bbl of crude per day, it is surpassed in capacity only by Sinclair's 14,000-bbl plant at Sinclair, and by Indiana Standard's 13,000-bbl refinery, also at Casper.

Operating on local (Wyoming) crudes, this Texaco refinery has been expanded and modernized recently to meet the competition of postwar processes for making motor fuels and other products. Foremost of the new additions is the fluid catalytic cracking unit, Kellogg-built, designed to process 4000 bbl of middle distillate to yield motor fuel, heating oils, and other products in heavy demand.

Also included is a combination atmospheric-vacuum unit for processing 10,000-12,000 bbl of Wyoming crude per day. The primary section of this unit removes gasoline, kerosene, and burning oils, with normally a portion of diesel fuel oil or light gas oil. The bottoms from this tower are heated to 700 F or higher and passed into a vacuum tower under approximately 28 in. of mercury, where the major portion of the gas oil or distillate fuel oil fraction is removed as charge stock for the catalytic cracker, for domestic heating oil, diesel fuel or any other of the many purposes for which it is suitable. The very heavy bottoms from this tower are suitable for road oil when reduced to, or cut back to the required viscosity and penetration or the bottoms may be reduced with steam or air or both to penetration

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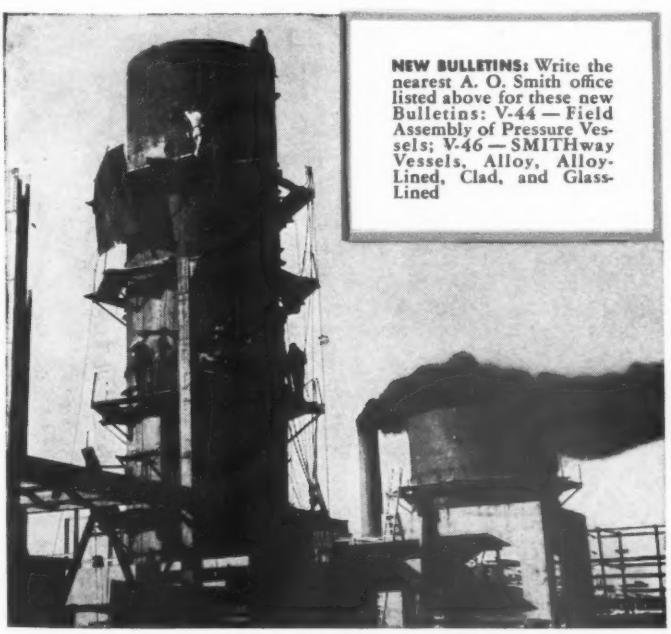
Harold Pollei (right), supervisor of A. O. Smith Field Service, is backed up by the vast metallurgical, welding, spectographic, and electrical laboratory facilities of A. O. Smith in solving the daily technical problems with Harry Drummond (left), job superintendent on the field work, and two of his foremen.



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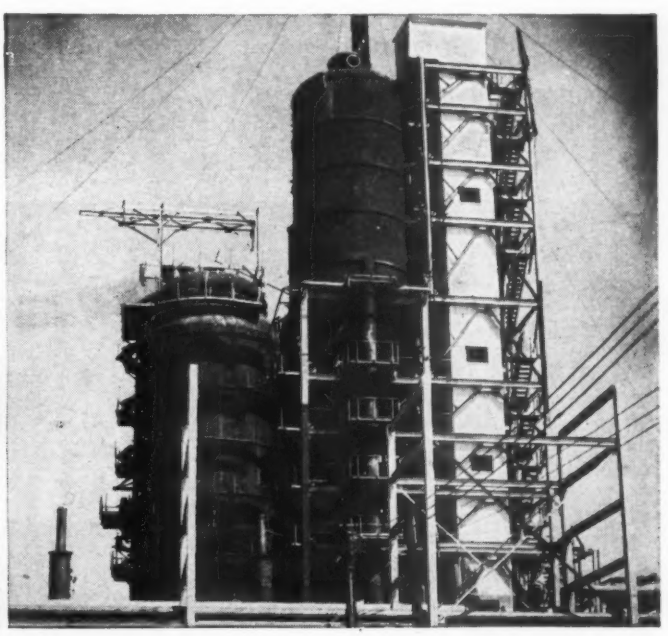


FLUID CATALYTIC CRACKING UNIT NEARING COMPLETION. At left is the regenerator, 20 ft. dia. x 79 ft. 8 in. high, weighing 334,000 lb. Right, the reactor, 22 ft. 6 in. dia. x 62 ft. high, weight 266,000 lb., is carbon moly SMITHlined with type 405 stainless steel.

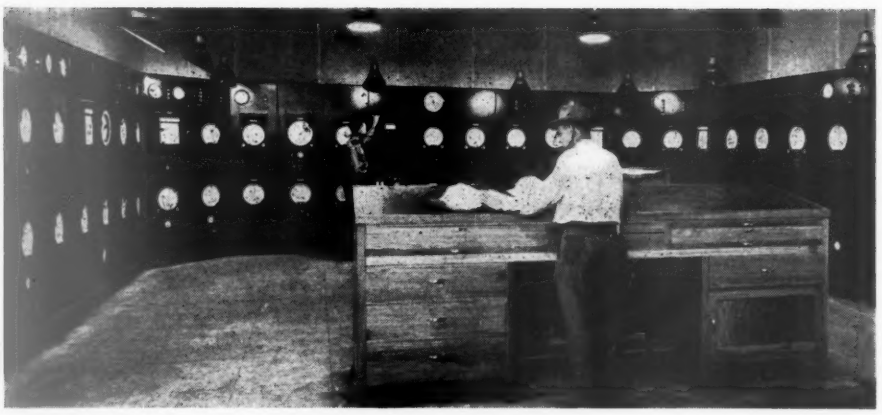


FIG. 2. Conning tower of fluid unit is the control room where operating conditions are recorded and the unit is kept on stream to required conditions.

asphalt for road-making and similar purposes.

A thermal naphtha reformer unit is provided, which reforms 2000 bbl per day of the heavy naphtha taken off overhead from the atmospheric unit, to improve octane rating and vapor pressure, for inclusion in motor fuels marketed in the Rocky Mountain area. The naphtha shows about 35 octane number by the ASTM or Motor Method, and is reformed to about 65 octane rating, to be blended with the light straightrun naphtha, catalytically cracked, gasoline and polymer gasoline produced in the plant. This reformer also produces considerable amounts of olefinic gases containing principally propylene and butylenes, which are polymerized in the catalytic (phosphoric catalyst) polymerization unit. This unit produces some 400 bbl per day of high octane rating polymer gasoline which improves markedly the average octane number of the plant's finished motor fuel output.

Catalytic recycle stock and possibly other heavy stocks in the plant are cracked in a thermal coke still, typical of the industry's operations along that line, employing elevated temperatures, several hundred pounds pressure and continued recycle to reduce the charge eventually to coke, which can be used as a solid fuel in the region. This thermally cracked naphtha is relatively high in octane rating, ranging between 65 and 70 by the Motor Method, and is blended with the other motor fuel components produced in the refinery.

Most of this charge is composed of course of the once-through heavy material from the catalytic cracker described below.

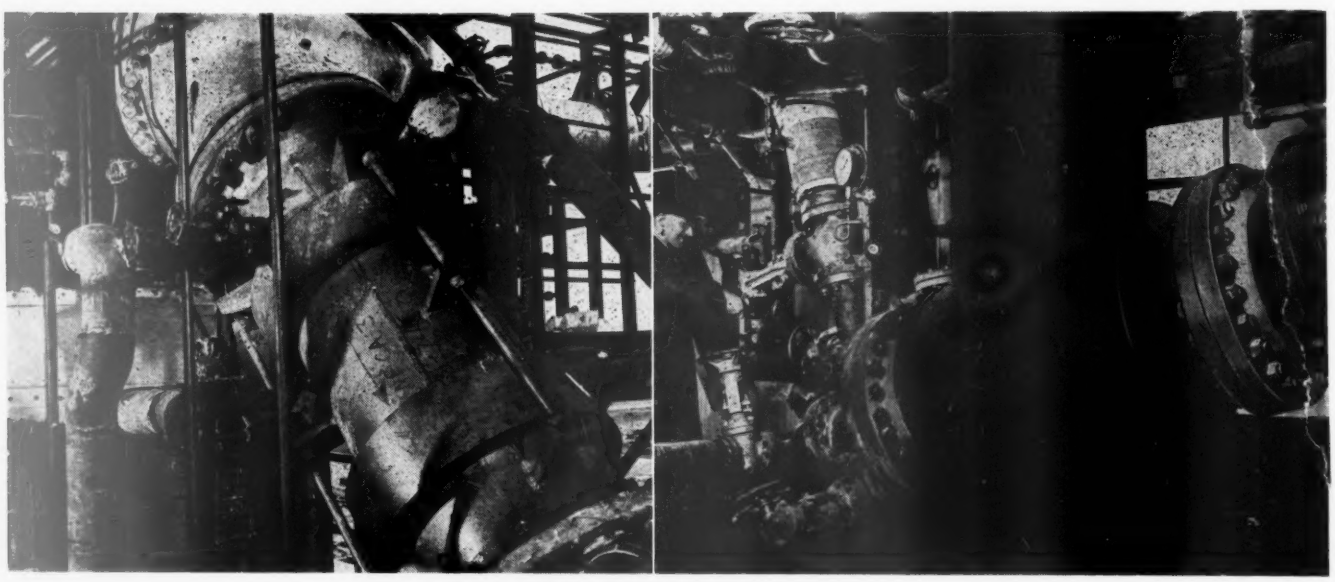
The catalytic cracking unit is based on the so-called fluid principle of operation, typical of a large number of large-capacity units built just before and during the last World War, and was designed and built by M. W. Kellogg Company. It is by way of being an example of the Lilliputian version of that system, of which several other units of comparable capacity, 3000-5000 bbl per day of charge, have been built in different parts of the country. The outstanding feature of this is that in it, for the first time, the new "balanced pressure principle" has been applied and has simplified the design considerably. By this method the regenerator and reactor are placed on the same level, and the great height of the earlier designs has been reduced importantly. Standpipes from reactor, regenerator, etc., are shortened which reduces the pressure drop across the various control valves. This has reduced greatly the erosion effects of catalyst as it passes these points, and cuts costs as well as operating down-

(Continued on Page 242)

You will find the numbers and locations of other Wyoming oil refineries and natural gasoline plants on the state map, page 188, this issue of the *Engineer*.

FIG. 3. Expansion joint in the catalyst-vapor line of the main unit.

FIG. 4. At this point the hot regenerated actalyst and the feed vapors are commingled en route to the reactor where cracking takes place.



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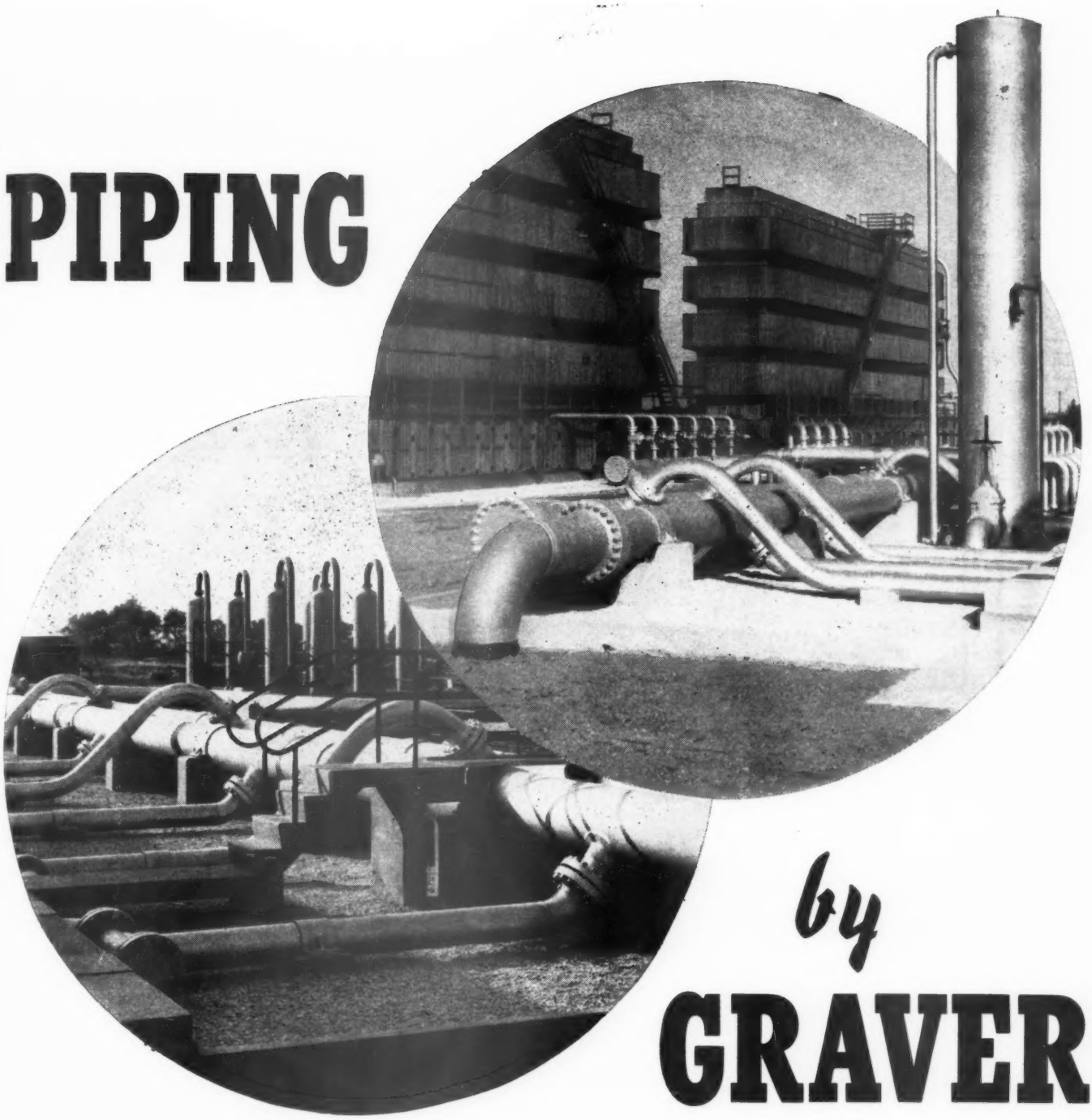

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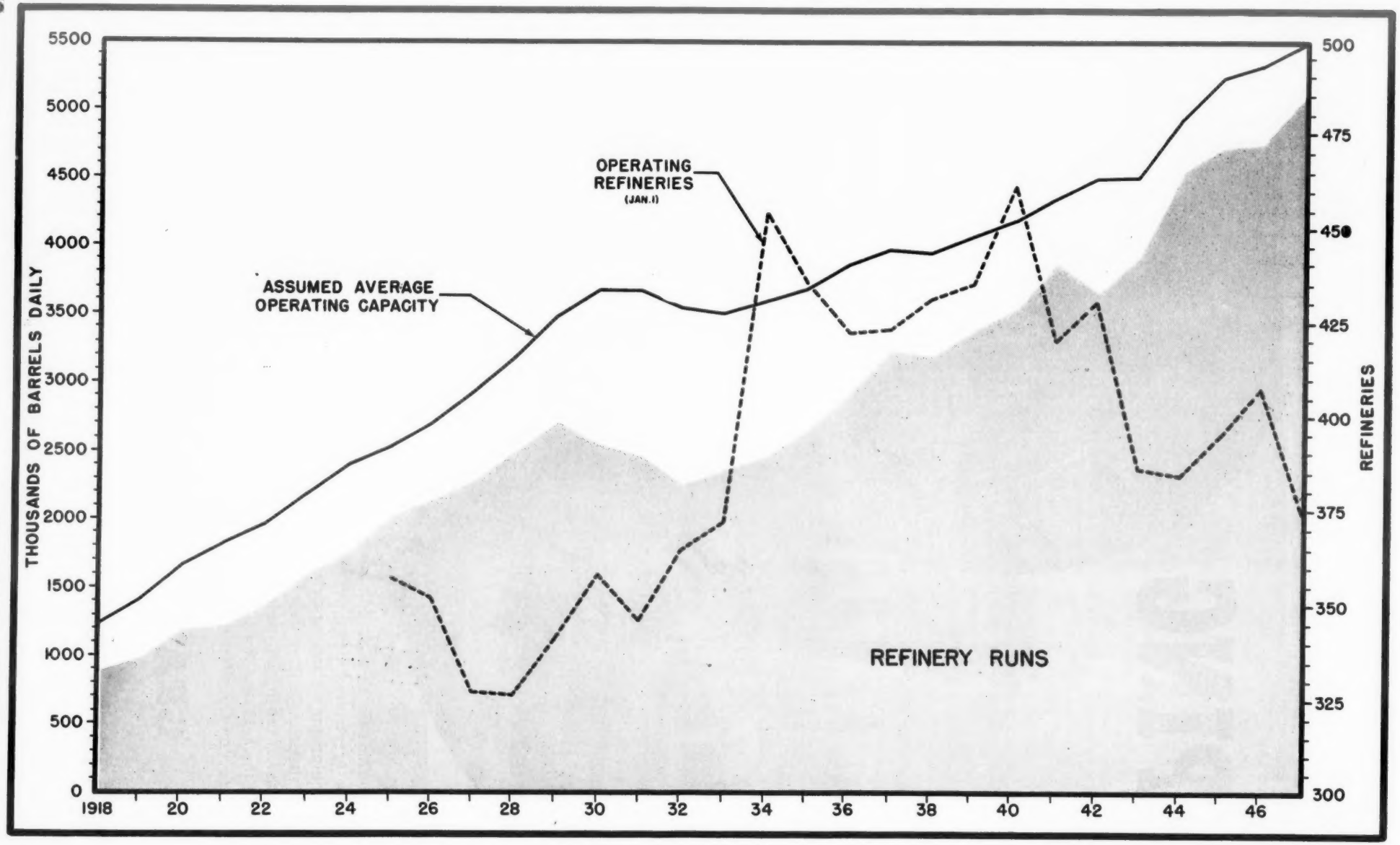

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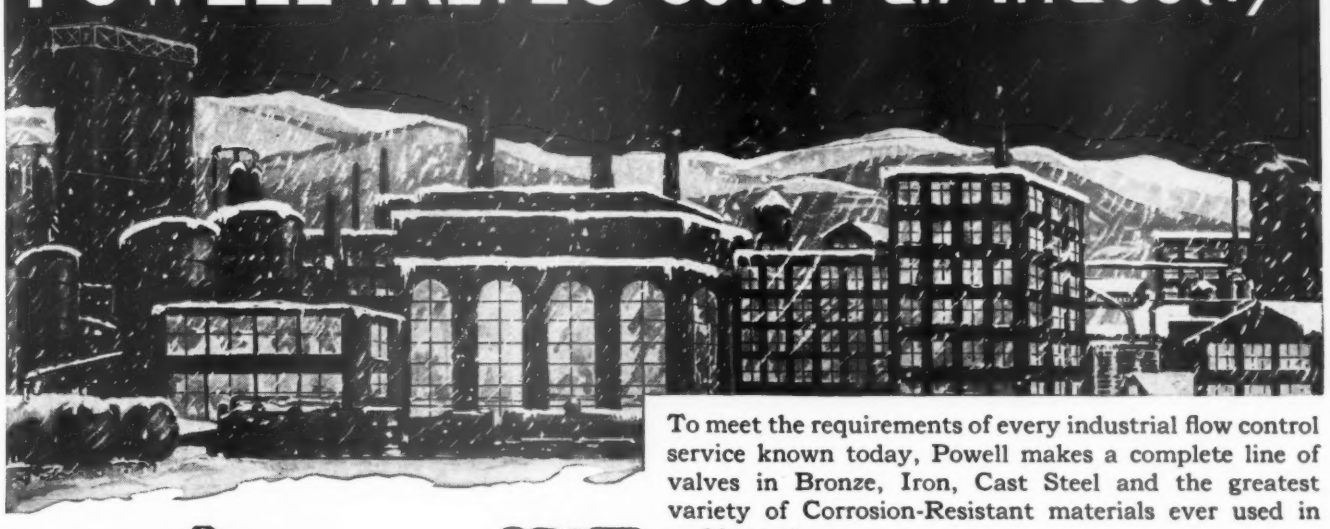

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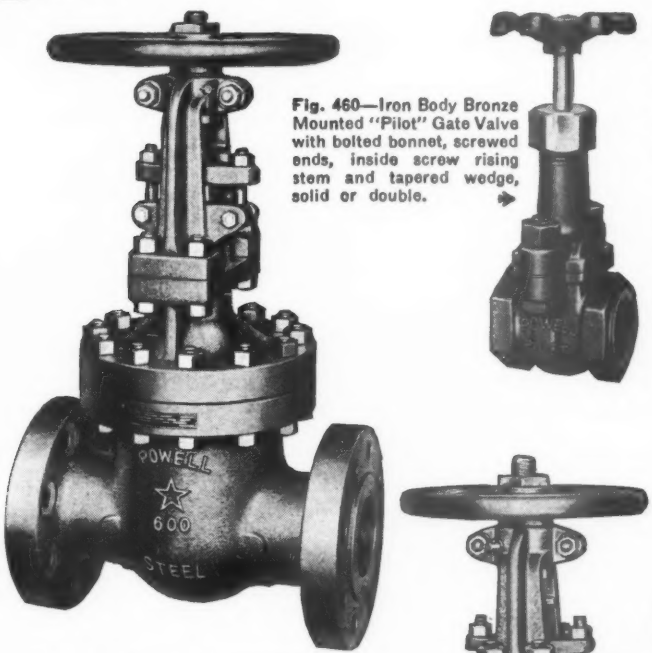

Fig. 460—Iron Body Bronze Mounted "Pilot" Gate Valve with bolted bonnet, screwed ends, inside screw rising stem and tapered wedge, solid or double. ➔

Fig. 6003—Class 600-pound Cast Steel Gate Valve with flanged ends, outside screw rising stem, bolted flanged yoke and tapered solid wedge.

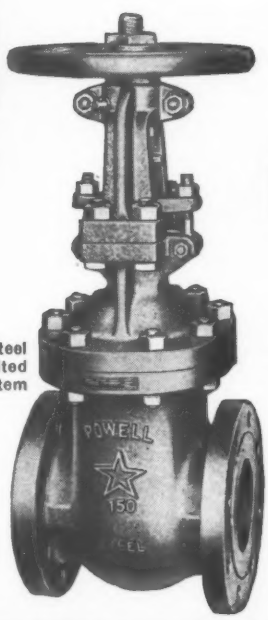

Fig. 1503—Class 150-pound Cast Steel Gate Valve with flanged ends, bolted flanged yoke, outside screw rising stem and tapered solid wedge.

For full information on applications of Powell Corrosion-Resistant Valves, refer to Powell Catalog No. 242. If you do not have it, write, on company stationery, for your copy NOW!

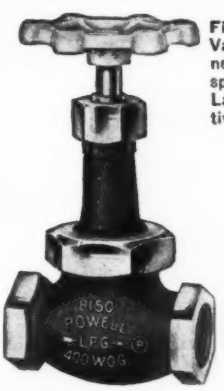

Fig. 8150—Bronze L. P. G. Globe Valve with screwed ends, union bonnet and special composition disc. Inspected and listed by Underwriters' Laboratories', Inc. Write for descriptive circular—8-48B.

Fig. 1444—125-pound Iron Body Bronze Mounted Gate Valve with outside screw rising stem, bolted flanged yoke and tapered wedge. ➔

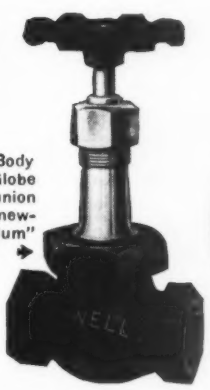

Fig. 190—150-pound Iron Body Bronze Mounted "Irenew" Globe Valve. Has screwed ends, union bonnet and regrindable, renewable wear-resisting "Powellium" nickel-bronze seat and disc. ➔

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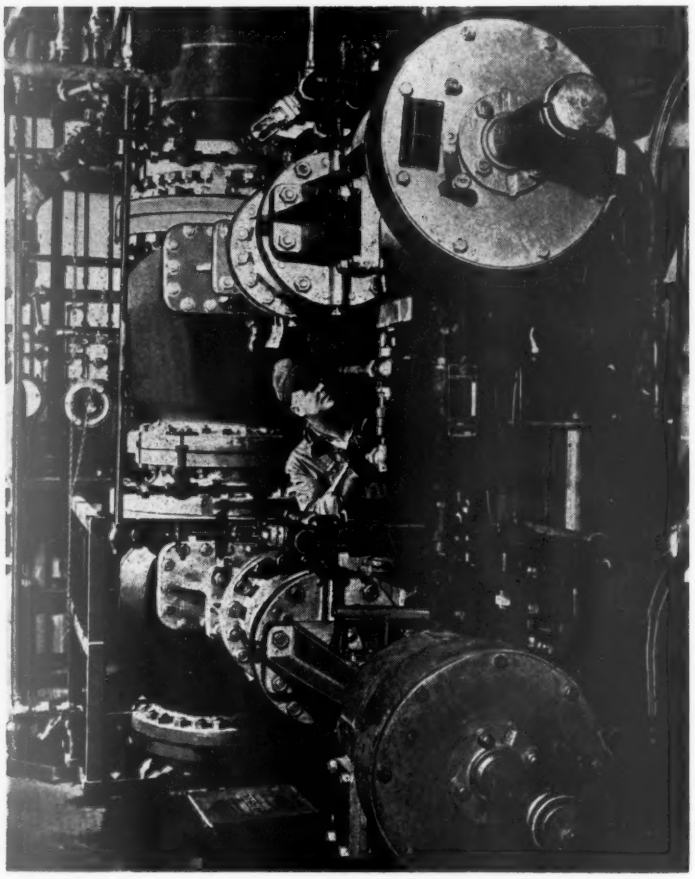


FIG. 5. The all-important regenerator standpipe valves are installed in duplicate to prevent or postpone emergency shutdowns. One valve is held wide open, as standby, while the other regulates the downflow of hot catalyst and thus controls the unit.

time, keeping the units on stream a greater proportion of the time. Because the unit is designed to process both sweet and sour crudes, the application of alloys in slide valves, pipes and lines, and in the reactor and regenerator is generous, employing chrome-moly and stainless steels, chrome-nickel such as 18-8, refractory brick and other aids for the reduction of corrosion-erosion effects.

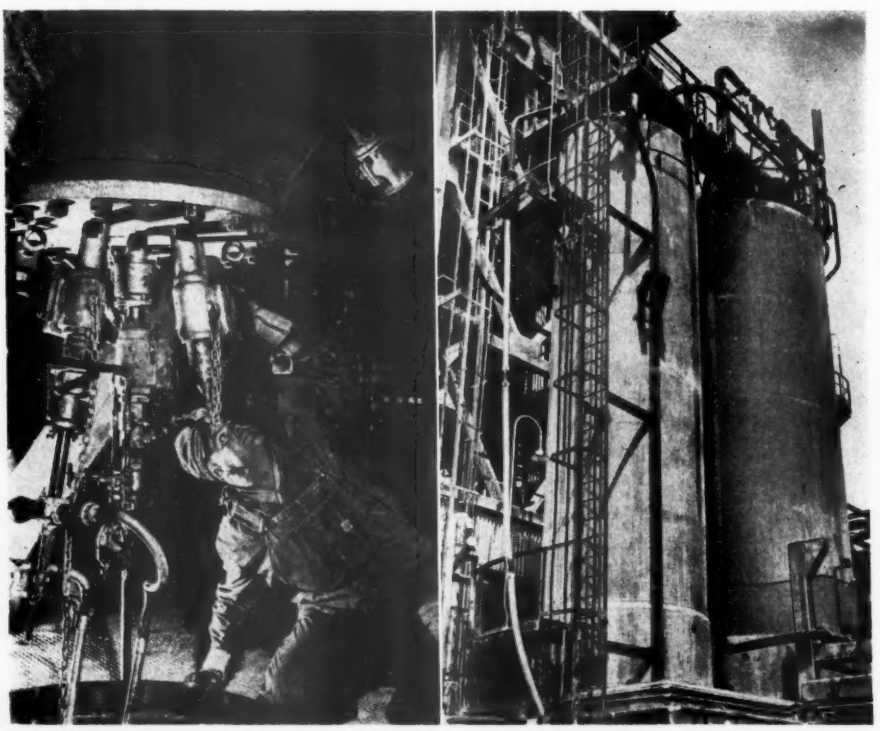
Also, this unit employs an outside stripper for the removal of the last traces of hydrocarbon material from the spent catalyst, and the return of these vapors to the reactor before the catalyst is sent to the regenerator. This reduces losses and increases yields correspondingly in the operation. The ground layout in rectangular form permitted the builder to erect any vessel whenever he chose, without being forced to wait for another vessel to arrive which would interfere with other items and their handling. Most of the vessels were fabricated in shops and transferred to the plant site.

The new type of precipitator is cylindrical and operates at high pressure, reducing cost, weight, and fabricating difficulties. In the fractionator is included the catalyst slurry settler, at bottom, from which the small amount of catalyst which escapes with the vapors is returned with heavy condensate to the cracking system without contaminating the product. A desuperheater section is part of the fractionator as is the rectifying or fractionating section proper.

The light oil treating facilities have been expanded, as has the equipment for making specification asphalt. The use of asphalt for road-building in the midwest and mountain states is increasing rapidly. The road improvement required is still great and a steady and increasing demand takes all the asphalt manufactured, as well as road oils and allied products. Because of the large amounts of otherwise waste heat available in the plant, it produces practically all the steam it needs for all purposes; therefore all pumps, etc., are steam driven. * * *

FIG. 6. An operator observes the flame in the air preheater which is used when the unit is starting cold to heat air for operating the regenerator. When the unit is on stream, heat generated elsewhere will be employed to preheat air or for other requirements.

FIG. 7. Used catalyst, right, and fresh catalyst, left, are stored in these two "hoppers." The larger bin at right can hold all the catalyst in the unit at one time, about 70 tons.



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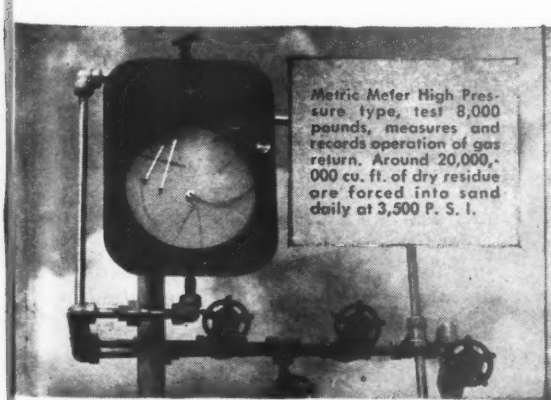
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TCC Unit Catalytically Processes Sour Gas Oil

By WILLIAM M. CARNEY*, HENRY D. NOLL†, and A. WESLEY HOGE*

A wide variety of operating conditions have been imposed upon the TCC unit in order to arrive at optimum product distribution in the overall refinery balance of products. Fresh feed throughput, recycle ratio and temperature have been the variables most widely studied. After considerable exploration of the effect of these variables, it was concluded that with the feed stocks available a low temperature operation with a nominal amount of internal recyling was most desirable at El Dorado. This type of operation gives an exceptionally high combined yield of 10 lb rvp motor gasoline and 600 F end point distillate fuel oil of about 70 vol per cent. The gasoline yield is further augmented to the extent of approximately 8. vol per cent of the virgin reactor charge by polymerization of the unsaturated portions of the C_3 and C_4 fractions. Typical TCC operating conditions and yields are given in Table 3.

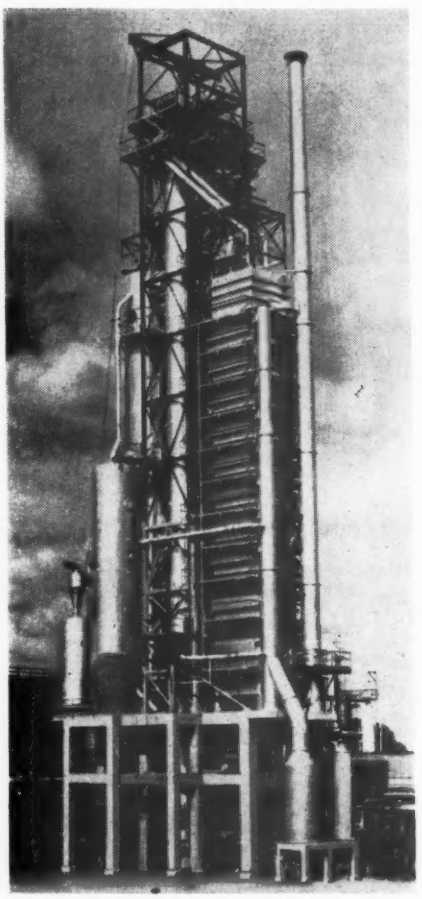
THE volume of high sulphur crude oils refined in this country has been increasing rapidly over the past several years. Vast quantities of Venezuelan and Near Eastern crudes are imported at present and the predictions are that over one million barrels per day of the latter crudes will be processed in this country within the next few years. These foreign crudes are characterized by high sulphur content, and in this and other respects are quite similar to the Arkansas crudes produced and refined by the Lion Oil Company at El Dorado. Arkansas. Table I gives inspections of the crude processed by Lion as well as inspections of typical Near Eastern and Venezuelan crudes.

TABLE 1.

Crude	Oficina (Venez.)	Bahrein	Iraq	Lion (Schuler)
Gravity—API....	31.1	32.7	35.5	34.5
TEP dist., °F				
IBP.....	83	..	..	86
5 per cent....	160	112	128	145
10 per cent....	220	186	197	210
20 per cent....	318	305	295	300
30 per cent....	396	402	380	395
40 per cent....	490	501	465	485
50 per cent....	563	600	547	595
60 per cent....	658	700	620	695
70 per cent....	791	806	723	785
80 per cent....	911	71.2% at 830	78.4% at 830	
Sulphur wt., per cent.....	0.81	2.04	1.92	1.40
Conradson carbon, wt. per cent...	..	7.75	3.6	3.1

Refinery processing system. The refinery operations at El Dorado are integrated about the operation of a 5400 bbl per day unit. After the recovery of certain straight run products from the crudes by conventional means, there is available heavy gas oil and reduced crude for charging stock to the TCC plant. Although the average sulphur content of the reactor charging stock derived from this mixture is about 1.7 wt per cent, such material has been processed successfully in the TCC unit since September, 1947. A typical inspection of the charge to the Lion TCC reactor is given in Table 2 along with inspections of gas oils of similar boiling range derived from Near Eastern and Venezuelan crudes.

*Lion Oil Company.
†Houdry Process Corporation.



Lion Oil Company's TCC unit at El Dorado, Arkansas.

TABLE 2.

Gas oil	Oficina (Venez.)	Bahrein	Iraq	Lion TCC charge
Yield—vol. per cent of crude..	30.0	35.0	32.0	30.0
Gravity—°API...	24.5	23.0	24.3	25.7
Vac. dist. °F				
IBP.....	550	550	570	484
10 per cent....	615	620	625	620
20 per cent....	655	660	670	670
30 per cent....	695	695	705	715
40 per cent....	735	725	740	750
50 per cent....	775	760	775	785
60 per cent....	820	795	815	825
70 per cent....	860	850	850	865
80 per cent....	890			910
Aniline pt., °F...	175	175	190	165
Sulphur, wt per cent.....	0.90	2.85	3.1	1.7

TABLE 3.

Charge data	BPSD*
Virgin charge to tar sep.....	5838
Recycle charge to tar sep.....	908
Total tar sep. charge.....	6746
Virgin charge to tar separator.....	5838
Recycle charge to tar separator.....	908
Total tar separator charge.....	6746
Tar separator bottoms.....	1183
Total reactor charge.....	5563
Virgin reactor charge.....	4655
*Barrels per stream day.	
Operating conditions	
Space velocity (total charge), V/hr/V.....	1.6
Catalyst/oil ratio (total charge), V/V.....	2.4
Top reactor pressure, psig.....	8.0
Oil vapor to reactor, °F.....	860
Catalyst to reactor, °F.....	1005
Catalyst circulation rate, tons/hr.....	72

Product yields	BPSD	Lb/hr	Volume per cent virgin reactor charge	Weight per cent virgin reactor charge
10 lb RVP, 410 F EP motor gasoline.....	2376		51.0	
No. 2 furl oil.....	855			18.4
Heavy catalytic gas oil	855			18.4
Excess C-'S.....	602		12.9	
C_4 plus liquid recovery			100.7	
3_3 and lighter gas.....		4390		7.2
Coke.....	2765			4.5

Tests on the products show that despite the low temperature operation, low sulphur content of the gasoline from a high sulphur charge is achieved. For example, after caustic treating in a regenerative system, the stabilized TCC gasoline has an average total sulphur content of about 0.10 wt per cent and is doctor-sweet. The stability of both the catalytic gasoline and No. 2 fuel meets all marketing specifications. Inspections of the various TCC product streams after gas recovery and stabilization are shown in Table 4. As indicated, the end point and the pour point of the No. 2 fuel oil produced are approximately 600 F and 0 F, respectively.

With the current trend in processing stocks of increasing sulphur con-

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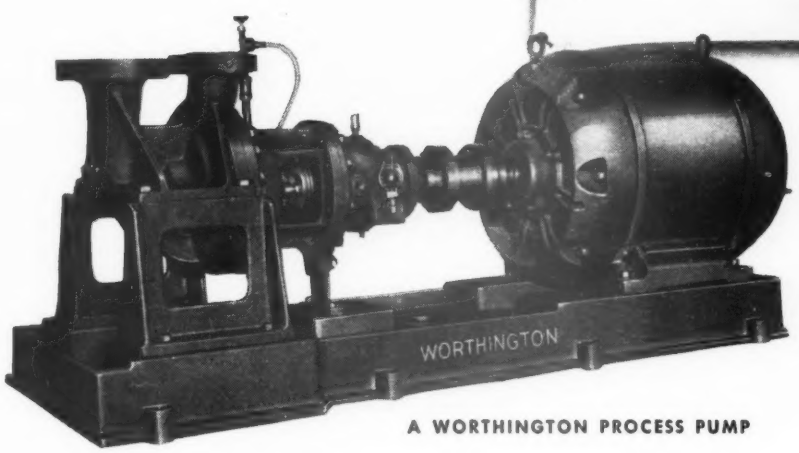

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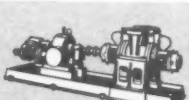
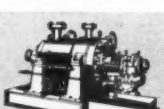


Type HD. Hydraulically-balanced, double-suction impeller handles boiling liquids with low submergence. Capacities range from 600 to 3200 g.p.m. at heads up to 700 ft., temperatures up to 850°F., pressures up to 550 lb.



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Type HL. Several construction arrangements permit flexibility in application. Designed for temperatures up to 225°F., or higher with water-jacketed stuffing box. Capacities up to 1600 g.p.m., heads to 500 ft.

TABLE 4.

	Stabilized gasoline	No. 2 fuel oil	Heavy catalytic gas oil
Gravity—°API	59.3	26.0	16.1
ASTM dist., °F			
IBP	90	448	613
50 per cent	202	520	702
90 per cent	374	571	760+
EP	408	600	
RVP	7.3		
Octanes			
M.M. clear	80.5		
+3cc TEL	86.3		
Res. Clear	92.0		
+3cc TEL	97.2		
Sulphur—wt. per cent	0.10	1.45	
Pour, °F		0	75
Aniline point, °F		116	

tent in catalytic cracking units in this country, it is of interest to study the distribution of sulphur in the products from such operations. With this in mind, sulphur balances for the Lion operations have been made. Typical of the results are the data presented in Table 5. Also included in Table 5 are typical sulphur balances for TCC operations on moderately sour and sweet charging stocks. Although a generalized correlation of sulphur distribution in the products versus sulphur content of the charge cannot be made for stocks of widely different chemical composition (the aromatic California crudes are notable exceptions) it is interesting to note that for most paraffinic and mixed-base stocks, about 55 per cent of the total pounds of sulphur in the charge appears in the gas and coke products, about 42 per cent appears in the cycle stock and about 3 per cent apepars in the catalytic gasoline.

The foregoing generalization regarding sulphur distribution is valid only at normal conversion levels of 55 to 60 per cent since the quantities of sulphur in the individual products depend upon the relative quantities of those products or, in other words, the conversion level. The change in sulphur distribution with change in conversion in TCC cracking is illustrated by the curves shown in Fig. 1. These graphs were developed from a large number of TCC runs made on a variety of charging stocks and over a considerable range of operating conditions. The data tabulated in Table 5 have been plotted on these generalized curves.

One of the most gratifying experiences in connection with the operation of the Lion TCC Unit on sour stocks has been the discovery that a minimum of chemical treatment of the catalytic gasoline is required to produce a non-corrosive, stable, doctor sweet product. It is generally recognized that sour stock operations involve much more elaborate finishing treatment of the products in order to meet marketing specifications. Prior to the installation of the TCC unit at El Dorado, for example, the thermal gasoline produced from the stocks currently being cracked catalytically had an average total sulphur content of 0.15 wt per cent after regenerative caustic washing and copper chloride sweetening. The TCC gasoline, however, is given only a regenerative caustic wash and inhibited, after which the total sulphur content averages about 0.10 wt per cent and the product is sweet to the doctor test. The untreated TCC gasoline leaving the stabilizer has a total sulphur content of about 0.15 wt per cent, about one-third of which is mercaptan sulphur. The mercaptan compounds present, however, are removed almost quantitatively by a strong caustic wash so that the finished product meets the specifications quoted above. The distribution of total sulphur versus boiling range of the Lion TCC gasoline before caustic washing is typified by the data plotted in Fig. 2.

TABLE 5. Sulphur distribution in TCC cracking.

	Lb per hr	Weight per cent sulphur	Lb per hr sulphur	Weight per cent of total sulphur
Lion gas oil.				
Reactor charge	65,800	1.70	1,118	100.0
Products				
Gasoline	27,600	0.14	39	3.5
Cycle oil	26,832	1.66	446	40.0
Gas+coke	11,368		633	56.5
Totals	65,800		1,118	100.0
Michigan gas oil.				
Reactor charge	39,200	0.61	239	100.0
Products				
Gasoline	15,460	0.046	7	2.9
Cycle oil	15,250	0.55	84	35.1
Gas+coke	8,490		148	61.0
Totals	39,200		239	100.0
Midcontinent gas oil.				
Reactor charge	129,000	0.14	530	100.0
Products				
Gasoline	41,900	0.049	21	4.0
Cycle oil	73,100	0.37	270	51.0
Gas+oil	14,000		239	45.0
Totals	129,000		530	100.0

FIG. 1. Sulphur distribution in TCC.

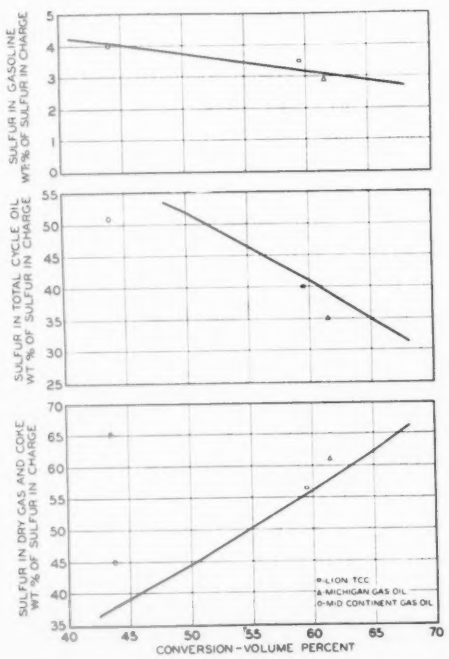

SULFUR IN GASOLINE WT % OF SULFUR IN CHARGE
SULFUR IN TOTAL CYCLE OIL WT % OF SULFUR IN CHARGE
SULFUR IN DRY GAS AND COKE WT % OF SULFUR IN CHARGE
●-LION TCC
▲-MICHIGAN GAS OIL
○-MID CONTINENT GAS OIL
CONVERSION-VOLUME PERCENT

FIG. 2. Total sulphur distribution of Lion TCC gasoline before caustic washing.

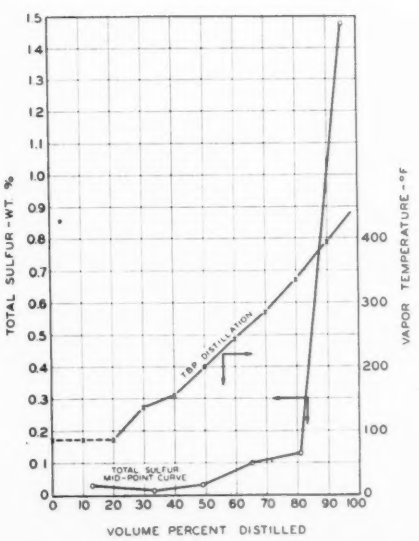
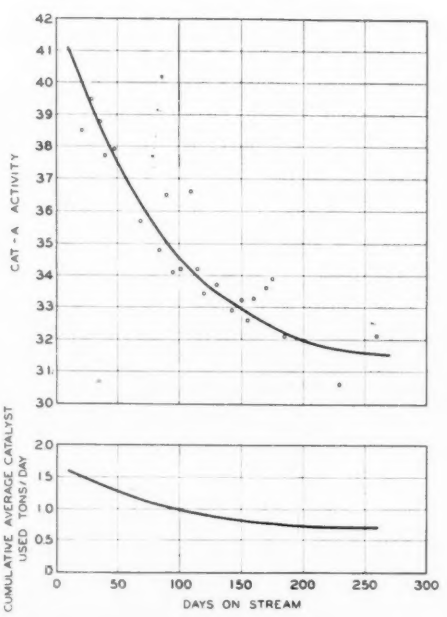


FIG. 3. Bead catalyst performance in Lion TCC cracking unit.



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Description of Lion TCC unit. The Lion TCC unit consists of the conventional heater, tar separator, reactor-kiln and distillation sections. Among the latest developments incorporated in the design at the time of construction are a single, split-bucket type, hot catalyst elevator for transporting both spent and regenerated catalyst, self-supporting reactor and kiln sections which result in an economy in the steel superstructure required, and a kiln-cooling coil manifold arrangement at the first platform in the structure which facilitates operation by permitting all coil changes to be made at this location. As far as the catalytic section is concerned, only the reactor proper has alloy protection against corrosion by the sour charging stocks. The hot catalyst elevator, kiln air blower and principal feed and product pumps are driven by steam turbines. In the event of a power failure, the TCC unit proceeds in operation very smoothly and already this foresight in planning has obviated many temporary shutdowns which would otherwise have occurred.

The catalyst used in the Lion TCC unit is the synthetic bead type. The normal catalyst inventory in the unit is about 225 tons and the initial charge of catalyst had an activity of 42 by the Cat-A method. After the first year of operation, the average activity of the system has leveled out at about 31 Cat-A index. The performance of the catalyst in the unit is shown graphically in Fig. 3. It should be mentioned that during this entire period of operation no catalyst has been withdrawn from the unit and replaced with fresh catalyst for the purpose of maintaining average activity. In other words, the only catalyst usage has been that required to replace nominal mechanical losses due to attrition. The actual average usage from September 1947 to the present has been 0.7 tons per day which is equivalent to about 0.24 lb per bbl of charge.

Aramco Training Center

Lease of several buildings, by Arabian-American Oil Company, at the wartime Suffolk County Airfield, out near the tip of Long Island, has been announced by W. F. Moore, Aramco president. The unit will be employed as an indoctrination center for the training of employees for overseas service with the company. The first class of 20 employees started its six weeks November 1. Number of trainees will be increased by 20 until a maximum of 120 is reached. The learning of colloquial Arabic will be stressed, Moore indicated.

The Lion TCC installation is composed of both new and used equipment with alloy steel protection provided only at critical locations. The vapor superheater, tar separator and the entire catalytic cracking section proper were new construction and the balance of the feed preparation distillation and recovery sections were parts of equipment previously operated in the refinery. Some of the existing equipment which was revamped for TCC service had already been provided with alloy protection for sour stock operation and, as previously mentioned, only the reaction zone of the TCC unit was alloyed. An itemization of the major pieces of equipment and the extent and type of alloy employed is given in Table 6.

The unit was shut down on April 4, 1948, for a complete inspection and clean-up after seven months' operation, during which time an on-stream efficiency of 97 per cent was realized. That the off-stream time to on-stream time for the turnaround amounted to only seven days is indicative of the excellent condition in which all of the equipment was found. A summarized report of the inspection is presented in Table 7. It is noteworthy that no piping replacements were required because of metal loss from corrosion or erosion despite the fact that as indicated in Table 6 much of this piping was fabricated of carbon steel. For example the vapor lines to and from the reactor are carbon steel. Undoubtedly, these lines operate at a temperature outside the critical range for corrosion by the Lion stocks. The significance of this experience, however, is that economies in the design of the Lion TCC plant for sour stock operation were realized by providing alloy protection at only critical locations.

TABLE 6.

Item	Material	Existing or added
Feed preparation		
Vaporizing heaters	4-6 per cent chrome tubing	Existing
Tar separator	11-13 per cent chrome lining complete	Added
Tar separator bottoms lines	4-6 per cent chrome pipe	Added
Tar separator vapor line and valves	Carbon steel	Added
Vapor superheater	2 per cent chrome tubes	Added
	4-6 per cent chrome headers	Added
Vapor line to TCC reactor and valves	Carbon steel	Added
Reactor		
Reaction zone	11-13 per cent chrome lining	Added
Reactor internal elements	18-8 stainless	Added
Reactor vapor outlet lines and valves	Carbon steel	Added
Synthetic crude tower		
Synthetic crude tower	11-13 per cent chrome lining in lower half—upper half carbon steel	Existing
Synthetic crude tower piping	Carbon steel	Added
Exchanger	Carbon steel	Existing
Synthetic crude tower overhead condensers	Carbon steel shell Admiralty metal tubes	Added
Overhead receiver and gas separator	Carbon steel	Existing
Kiln		
Kiln internals	Conventional 4-6 per cent chrome air and flue gas distributors and collectors—2 per cent chrome water tubes	Added

TABLE 7.

Item	Condition
Feed preparation	
Oil charge lines and exchangers	Excellent—no metal loss
Vaporizing heater tubes	Excellent—no metal loss
Tar separator	Alloy lining good except for one broken strip weld
Tar separator bottom lines	Excellent—no metal loss
Tar separator vapor line	Good—no metal loss
Vapor superheater tubes	Good—no metal loss
Vapor-line to reactor	Good—no metal loss
Reactor	
Reactor shell	Excellent — alloy lining good except for six broken strip welds
Reactor internals	Excellent — no evidence of erosion or corrosion
Reactor vapor line and valves	Excellent — no evidence of corrosion
Synthetic crude tower	
Synthetic crude tower	Tower clean — lining in good condition
Synthetic crude tower piping	Excellent — no evidence of corrosion
Overhead condensers	Good—no fouling or evidence of sulphur attack on admiralty metal tubes or carbon steel shell
Overhead receiver	Good
Kiln	
Suspended tile lining	Excellent—no erosion or spalling
Air and flue gas distributors	Excellent
Cooling coils	Good—very slight scaling on inside
Catalyst piping	Excellent—no replacement required
Hot catalyst elevator	
General condition	Excellent—indicated chain life 3 years
Traction Rims	0.049 in. maximum wear
Chain links	0.0237 in. maximum wear
Chain knuckles	0.078 in. maximum wear

Conclusion. At this writing, the Lion TCC unit as El Dorado, Arkansas, has been in operation for more than a year—September 16, charging sour stocks similar to those derived from Middle Eastern and Venezuelan crudes with gratifying results. With a minimum of alloy protection against corrosion, the unit gives evidence of continued performance equal to that of any other commercial catalytic cracking unit operating on sweet stocks. In addition, a minimum of finishing treatment of the TCC products is required. Therefore, it is concluded that imported sour crudes could be processed satisfactorily at El Dorado without any further revisions to equipment or processing schemes. ★ ★ ★

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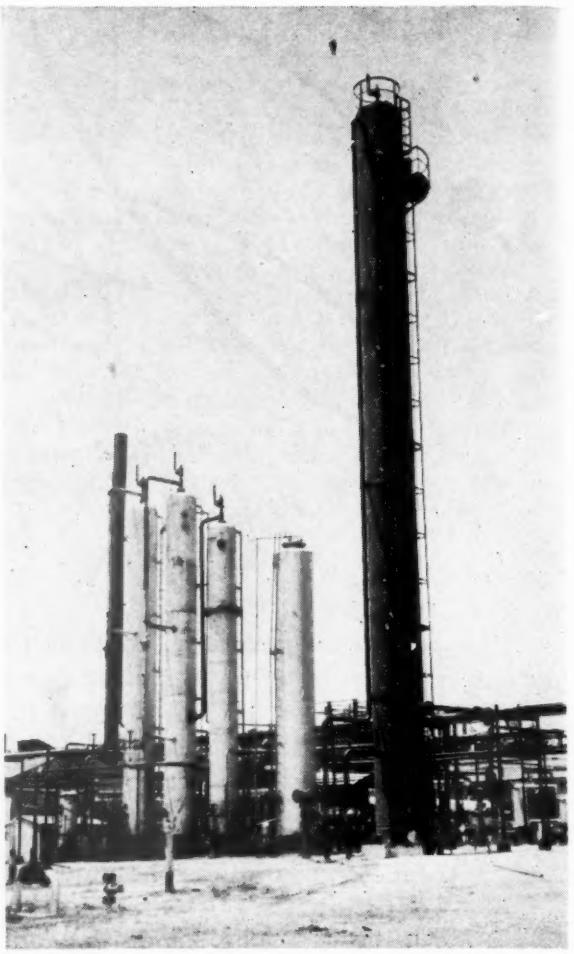
Convert Sligo Plant to Higher Pressure

By DON ATTAWAY, Arkansas Fuel Oil Company



The 86-ft high-pressure absorber is on the right. at extreme left are the high pressure and low pressure reabsorbers.

IN the fall of 1936, the Arkansas Fuel Oil Company erected and placed in operation their Sligo gasoline plant to process the gas from four wells in the Sligo field, southern part of Bossier Parish, Louisiana. In the original plant all equipment was designed for a working pressure of 400 psi and a capacity of some 10,000,000 cu ft daily. The plant actually operated on a line pressure of approximately 450 psi and was equipped to manufacture natural gasoline, distillate, and a small amount of butane. As the years passed, certain additional processing equipment was added to meet the requirements of increased capacity, but the original operating pressure was maintained.

Since that time a slow but continuous exploration and development of the field has resulted. Sixteen of the new high pressure gas wells completed in the field were tied into the plant gathering system. Several of these wells are dual completions, producing from the Jeter and the Pettit sand.

Early in 1947, it became apparent that to meet the increased gas requirements of the Arkansas Louisiana Gas Company it would become necessary to provide equipment of a higher operating pressure and increased capacity, this would call for a revamping of the entire plant with some radical changes in process design.

A gas analysis showed a natural gasoline content of about 328 gal per million cubic feet and a considerable amount of butane and propane. In addition, the majority of the wells produced a worthwhile amount of condensate.

After an engineering study of the field, a plan was prepared to enlarge the plant to a 40,000,000 cu ft daily capacity at an operating pressure of 600 psi. Facilities for complete gasoline extraction and the production of a butane-propane mixture were designed.

A shortage of steel and inability to procure new material and equipment was partially overcome when the company planned to utilize some of the required equipment from their abandoned refinery in Bossier City, Louisiana, some 14 miles from the Sligo plant.

Actual construction or conversion began in the fall of 1947 and on June 14, 1948, the plant was shut down for the change-over of units to the new process and operating pressure.

▸ **Absorbers.** Very little of the original plant equipment was left in service after the change-over. Today the gas from 20 wells is gathered in 6-in. and 8-in. field lines and delivered into the plant inlet meter runs at approximately 690 psi. Separators on these runs trap the fluid or condensate from the inlet gas stream while the wet gas is passed into a new 5-ft by 80-ft absorber and stripped of its gasoline content. The dry gas is delivered to the Arkansas Louisiana Gas Company transmission system for delivery to its main line.

The fluid from the inlet separators is sent into a 40-in. by 38-ft distillate separator, formerly a low pressure absorber in the old plant process. This vessel operates at 400 psi and vapors flashed here are charged into a 4-ft by 43-ft high pressure reabsorber. The raw distillate is then passed from the bottom of this tower into a 5-ft by 30-ft horizontal distillate settling tank operating at 100 psi. Water bottoms are drawn off here and the secondary flash vapors are released into a 4-ft by 43-ft low pressure reabsorber, operating at 70 psi. The raw distillate then passes into a 5-ft by 20-ft rich oil flash tank.

Both reabsorbers in this operation were formerly part of the high pressure absorber unit of the old plant and were converted to this new service in the revised process.

▸ **Rich oil cycle.** The rich oil from the bottom of the main plant absorber is charged into the high pressure reabsorber and trapped from the bottom of this vessel into the rich oil surge tank where the raw distillate has accumulated. This surge tank operates at 70 psi and the vapors released here join the vapors from the distillate settling tank and pass through a 6-in. vapor line to the low pressure reabsorber. The overhead vapors from both reabsorbers are recovered for use in the plant fuel system.

All raw distillate and rich oil are merged in the rich oil flash tank. The low pressure reabsorber is charged from this tank. It will be noted at this point that the raw distillate has been subjected to three distinct pressure drops ranging from 600 psi down to 70 psi, while the rich oil moves through the same pressure range with only two

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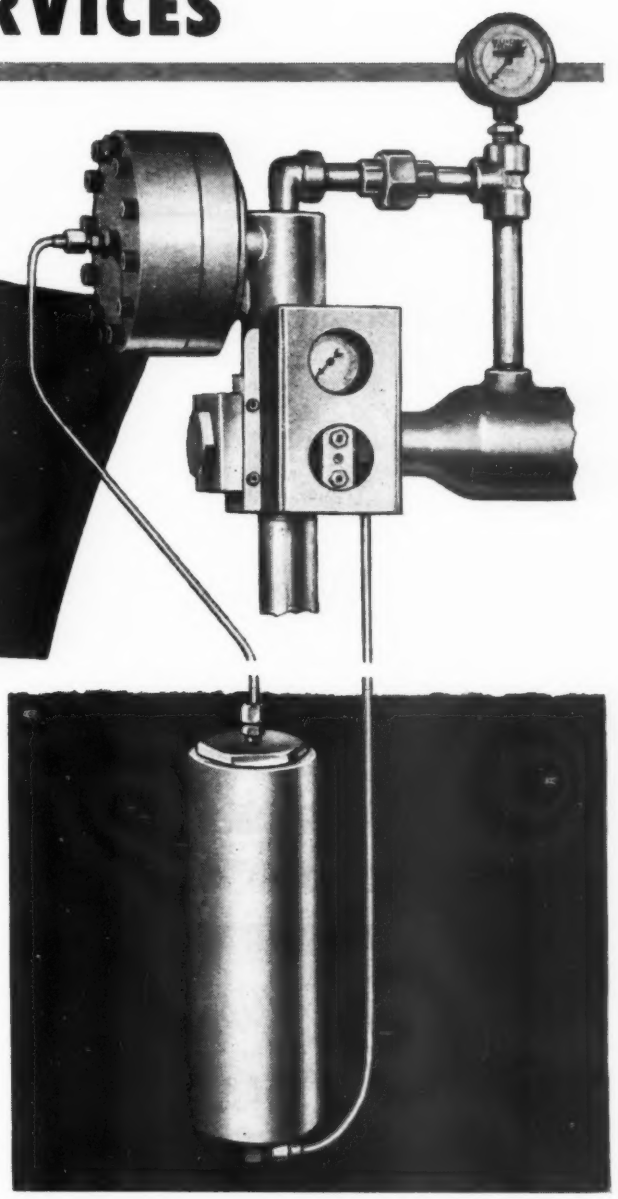

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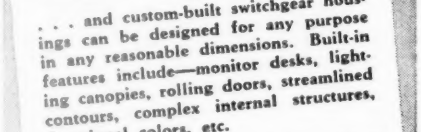

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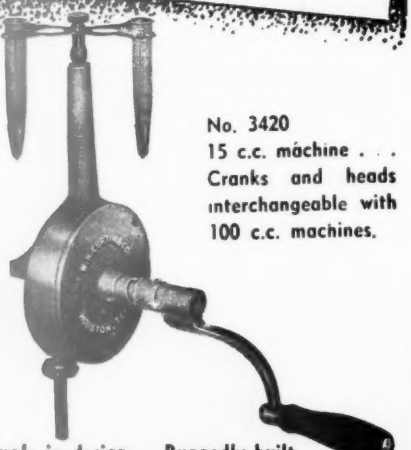

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pressure drops. The result is believed to produce a more stabilized and uniform rich oil charge to the heater.

▸ **Direct fired heater.** This rich oil is moved first through a vertical bank of four heat exchangers by means of a centrifugal pump driven by a 70-hp turbine and thence to a two-pass Isoflow radiant furnace where the oil temperature is raised to 390 F. This direct fired heater operates with an inlet pressure of 130 psi and has a capacity of 31,000 gal per hr.

▸ **Fractionators.** Instead of the conventional steam reboilers on fractionating equipment, the hot rich oil from the heater is passed through the debutanizer and deethanizer reboilers where temperature recorder-controllers operate bypass valves to maintain the required temperatures. From this service the enriched oil is charged into a 6-ft by 52-ft still operating at 100 psi and the overhead vapors are condensed in a water-cooled shell-and-tube vessel and collected in a horizontal 4-ft by 23-ft raw gasoline accumulator. Reflux for the still is taken from this accumulator by a 6-in. by 4-in. by 6-in. reciprocating pump. An 8 by 4 by 12 pump charges the 52-in. by 32-ft debutanizer column, formerly a stabilizer tower in the old plant process. From the reboiler on the bottom of this column, a 10-lb Reid vapor pressure natural gasoline is produced. The overhead vapors are condensed through two shell-and-tube water-cooled condensers and accumulated in a 4-ft by 17-ft horizontal tank. Vapors from this accumulator are piped into the low pressure reabsorber for recovery.

From the debutanizer reflux accumulator an 8-in. by 7-in. by 16-in. reciprocating pump refluxes the column while a 12-in. by 5-in. by 12-in. steam pump charges the deethanizer column. A feature in this unit is a standby 12 by 5 by 12 pump so connected that it can serve either as a spare reflux or charge pump on either the debutanizer or deethanizer.

The overhead vapors from the deethanizer are cooled through a water-cooled shell-and-tube condenser and collected in a horizontal reflux accumulator. Excess vapors from this vessel are also passed into the low pressure reabsorber for recovery. A 5-in. by 5-in. by 12-in. reciprocating steam pump serves for reflux operation. The butane produced from the reboiler on the deethanizer is used as a preheater for the column charge and is cooled through a shell and tube condenser before going to storage .

▸ **Exchangers and coolers.** The lean oil cycle from the bottom of the still begins with the hot lean oil passing countercurrent with the incoming rich oil through a bank of four shell-and-tube heat exchangers. The bank of exchangers is mounted vertically one above the other and an overhead 12-in. I-beam and hoist has been installed for facility in pulling tube bundles. Out of the exchangers, the lean oil accumulates in a horizontal lean oil surge tank at 70 psi pressure and 140 F. From this accumulator the lean oil is picked up by pumps for circulation over the absorbers and passed through a bank of two shell-and-tube coolers to lower the lean oil temperature. A 7½-in. by 5-in. by 10-in. reciprocating steam pump takes suction from the lean oil accumulator and discharges through a shell-and-tube water-cooled condenser thence into the low pressure absorber. For lean oil charge to the high pressure absorber and reabsorber, an 8-stage centrifugal pump driven by a 425-hp gas engine discharges through two water-cooled shell-and-tube coolers and thence into a 6-in. charge line. From this line, the lean oil over the

Plant inlet and outlet meter runs.

high pressure reabsorber is regulated by an adjustable choke. The balance of the lean oil goes to the main high pressure absorber. A stand-by lean oil pump and gas engine is maintained for this operation.

By means of a gas equalizing line from the 400 psi reabsorber and a regulator, a constant pressure of 70 psi is maintained on the lean oil surge tank.

▸ **Vapor recovery.** To conserve and utilize all plant vapors, a recovery system is maintained. All vapors from the finished product stock tanks are collected through a scrubber and picked up by a recompressor and discharged at approximately 35 psi through a water-cooled condenser into a vertical separator. All condensate from the scrubber is trapped by a liquid level control into an accumulator. The rich gas vapors are compressed a second time by a recompressor and discharged at 175 psi through a water-cooled condenser. The condensate trapped in the second-stage separator is dumped by a liquid level control into the same accumulator and the stripped gas vapors are passed into the plant fuel gas system.

At such time as sufficient raw condensate or gasoline is accumulated from the vapor recovery system a reciprocating steam pump transfers the production into the raw gasoline accumulator.

▸ **Storage.** For butane production, four 10-ft by 30-ft horizontal tanks have been installed. The original plant storage battery of four 10-ft by 40-ft tanks, three 7-ft by 30-ft tanks, and one 8-ft by 35-ft tank are utilized for gasoline production. Plant absorption oil is stored in one 7-ft by 40-ft horizontal tank, one 9½-ft by 15-ft tank and a 10-ft by 12-ft vertical tank.

▸ **Water system.** Water for plant operation is procured from two deep wells on the plant site. The deepest well, some 420 ft, is the plant main water supply while a 165-ft shallow well serves as a standby.

A new aerator type cooling tower has been installed to meet enlarged cooling requirements. The new tower is 16 ft wide and 47 ft long and contains 7 bays. Two 70-hp right angle drive water pumps operating at 1760 rpm are driven by 72-hp turbines and maintain water circulation throughout the plant.

▸ **General.** Plant steam requirements are supplied by three 75-hp locomotive type fire-tube boilers and two 110-hp water-tube stirling type boilers housed in a sheet metal building. A 7.5-kw steam turbine generator supplies electricity for plant lighting. Elevated flood lights around units and throughout the plant yard facilitate night operations.

A new 24-ft by 24-ft three-room cinder block office building has been erected to house the plant laboratory and superintendent's office.

Plant production is moved by rail and motor transport. A sub-type tank truck loading rack has been erected adjacent to the plant site and a 2-in. loading line runs from the plant to a spur and loading rack some seven miles north on the I.C. railway near Haughton, Louisiana.

The entire project from engineering through construction was supervised and erected by personnel available in the National Gasoline Department. At the present time, a glycol dehydration unit having a 5-ft by 35-ft vertical contactor is being installed for the removal of water vapor from the gas stream.

The revamped plant has shown considerable increased production and operates much more efficiently than the old process, and in view of the benefits obtained and results accomplished, study is being given to the possibility of increasing the capacity and working pressure of other line plants operated by the company. ★★

CATALYTIC REACTIONS AND PROCESS DESIGN HOLD ATTENTION OF CHEMICAL ENGINEERS

INTERESTING new data on the heat of catalytic cracking and the energy of catalyst regeneration, on factors governing the design of catalytic reactors, production of "Synthesis Gas" and other fields of importance to the chemical engineers in the petroleum and petroleum chemical industries occupied the attention of the members of the American Institute of Chemical Engineers at the French Lick meeting September 15-17.

Methods for the preparation of gas mixtures containing carbon monoxide and hydrogen, varying from ratios of 1:1 of these two gases to mixtures containing 90 per cent carbon monoxide and 10 per cent hydrogen were discussed by E. L. Clark and associates of the Bureau of Mines at Pittsburgh. The heat of catalytic cracking of East Texas gas oil varies with the degree of conversion, say J. C. Dart and A. G. Oblad of Houdry Process Corporation. Cracking at 850 F the reaction is endothermic, with 57 Btu per lb at 35 per cent conversion of the charge stock: at the same temperature and 80 per cent cracked, the reaction is exothermic, 222 Btu per lb of oil feed. The abstracts given below indicate the more outstanding facts disclosed during the meeting.

▸ **The Heat of Cracking and Regeneration in Catalytic Cracking.** *By J. C. Dart and A. G. Oblad, Houdry Laboratories, Houdry Process Corporation, Marcus Hook, Pennsylvania.*

The heat of cracking and of catalyst regeneration are important in the design of catalytic cracking units to allow the calculation of heat balances around the reactor and the regenerator. Pilot plant runs have been made at different cracking severities on East Texas gas oil using a silica-alumina bead catalyst. The heat of cracking and regeneration have been determined from precise calorimetric combustions carried out on the feed, the liquid product, and the catalyst residue. The heat of combustion data were corrected to a standard state of 1 atmosphere pressure and 77 F.

The heat of cracking data have been combined with available enthalpy data to obtain the heat of cracking at 850 and 900 F. The heat of cracking has been found to vary with conversion. At 850 F cracking temperature it varied from an endothermic reaction of 57 Btu/lb at 35 per cent conversion to an exothermic reaction of 222 Btu/lb oil feed at 80.0 per cent conversion.

In the reactor of a commercial cracking unit, dehydration of the catalyst also occurs during cracking. Corrections have been made for the heat of hydration on both clay and synthetic type catalysts in order to obtain the overall heat of reaction occurring in catalytic cracking.

The heat of combustion of the catalyst hydrocarbon residue has been determined experimentally as a func-

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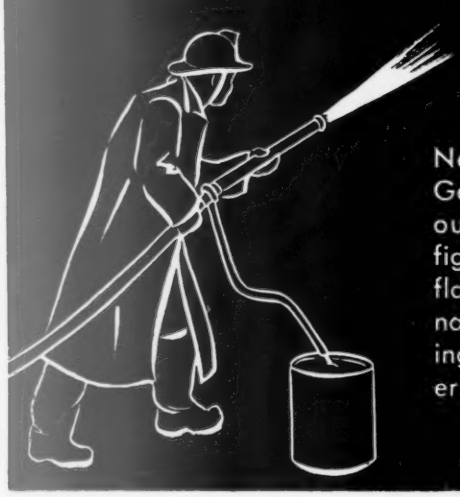

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*Patents pending on this new Foamite Airfoam-Generating Nozzle.

Shown is sectional view of Model 600 Foamite Airfoam-Generating Nozzle. It mechanically creates Foamite Airfoam thru a scientific mixing of water, air, and Foamite Airfoam Liquid. Phantom view shows specially designed "tear drop" obstruction for giving stream equal velocity on leaving tip. Note wire-reinforced pick-up hose construction.

Foamite Airfoam-Generating Nozzles, Models 600 and 300.

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tion of the amount of carbon on the catalyst and was found to be almost constant at 14,250 Btu/lb of residue.

Design of Gas-Solid Catalytic Reactors. *By R. E. Hall and J. M. Smith, Purdue University, Lafayette, Indiana.*

To date no experimental substantiation has been presented for any of the theoretical methods developed for the design of pseudo-isothermal (constant jacket temperature) gas-solid, catalytic converters. The overall objective of this investigation was to obtain the necessary data for evaluating the accuracy of such design by one of these existing methods. The work consisted of four important phases:

1. Measurement of reaction rate for the catalytic oxidation of sulphur dioxide in a differential (small bed depth) reactor over the range of conditions encountered in the integral reactor (large bed depths).

2. Measurement of effective thermal conductivities under the same conditions in the integral reactor.

3. Measurement of the radial temperature distribution in gas and catalyst and the conversion, both at various catalyst bed depths in the integral reactor.

4. Prediction of temperature and conversion in the integral reactor using Grossman's method and the data determined in 1 and 2 for comparison with the experimental results of 3.

For a fixed reactant gas composition to the differential reactor, the reaction rate was found to be essentially a linear function of temperature except at very low conversions where it followed the Arrhenius relation.

Overall effective thermal conductivities, K, were found to be about 0.2 Btu/hr ft ° F for the conditions employed in the flow system. There is evidence that the value of K decreases as the tube wall is approached.

Despite flow in the turbulent range according to a modified Reynold's number, the radial temperature distributions in both the solid and gas phases are parabolic in nature, indicating little lateral mixing and suggesting the possibility of anomalous steamline flow arising from the channeling effect.

Results of temperature distributions and conversions computed by the Grossman method are in good agreement with experimental results near the center of the tube. Increasingly wider deviations as the tube wall is approached indicate that K should decrease as the wall is approached, thus lending validity to the trend obtained in the experimental conductivities.

It is believed that accurate prediction of temperature distribution and conversion by the Grossman method will be possible when accurate correlations of K with packing and flow conditions and radial position are available.

Synthesis Gas Production in Commercial Equipment by the Reaction of Light Hydrocarbons, Steam, and Carbon Dioxide. *By E. L. Clark, R. H. Kallenberger, R. Y. Browne and J. R. Phillips, U. S. Bureau of Mines, Pittsburgh, Pennsylvania.*

Natural gas of the composition $C_{1.17}H_{4.3}$ is reacted with steam and carbon dioxide to produce mixtures of hydrogen and carbon monoxide suitable for the Fischer-Tropsch synthesis. The preparation of "synthesis gas" having hydrogen to carbon monoxide ratios of 2:1 and 1:1 (gases of this composition are most likely to be used in synthetic fuel production) as well as gases containing up to 90 per cent carbon monoxide—10 per cent hydrogen is described. Flow diagrams and a description of the plant facilities are given.

Thermodynamic Properties of n-Butane. *By H. William Prengle, Jr., L. R. Greenhaus and Robert York, Jr., Carnegie Institute of Technology, Pittsburgh 13, Pennsylvania.*

Normal-butane is useful as a refrigerant and as a raw material for preparing four-carbon-atom hydrocarbons. In order that quantitative calculations may be made for the energy effects involved in compressing, condensing, evaporating, throttling, heating, or cooling of pure butane, thermodynamic properties such as enthalpy and entropy are needed. These properties have been evaluated over a range from the liquid at its normal boiling point to the gas at 540 F, 300-atm. They are presented both as a table and as a pressure—enthalpy diagram.

High Pressure Vapor Liquid Equilibria Activity Coefficients for Ideal Systems. *By K. A. Smith and K. M. Watson, Department of Chemical Engineering, The University of Wisconsin, Madison 6, Wisconsin.*

For application to ideal systems of components having no chemical dissimilarity, generalized correlations are developed for vapor-phase and liquid-phase activity coefficients which express deviations from the laws of ideal solutions in two phase mixtures at high pressures. The activity coefficients are used in conjunction with thermodynamic equilibrium constants derived from modified definitions of the standard states of unit activity proposed by Gamson and Watson.

These consistent correlations of equilibrium constants and activity coefficients may be used to approximate the equilibrium vaporization ratio y/x for any component at conditions up to the true critical point of the mixture and in the regions of retrograde condensation. Deviations from experimental data for the paraffin hydrocarbons are generally less than 15 per cent. Vapor and liquid compositions, dew points, and bubble points may be calculated by straightforward and reproducible methods with accuracy sufficient for many purposes.

Distillation Column Design for Processing Polymerizable Compounds. *By K. E. Coulter (Junior Member), Dow Chemical Company, Midland, Michigan.*

The basic problems to be considered in the design of equipment to handle polymerizable compounds are discussed. Mention is made of polymerization rates, inventory time, temperatures, pressures, instrumentation, and auxiliary equipment. Typical data are given on the effectiveness of various inhibitors for styrene and ethyl-vinyl-benzene-divinylbenzene mixtures.

The complications and difficulties encountered from small air leaks, short induction and gel periods, operational upsets, and presence of cross-linking polymers have been discussed. Methods of cleaning columns, plugged with polymers made from commercial monovinyl monomers and those from cross-linked monomers, are given. It is pointed out that pure monovinyl monomers give polymers which are thermoplastic and soluble in common solvents but polymers formed from monomers capable of cross-linking with themselves or monovinyl monomers are usually thermoplastic and insoluble. Polymers of the latter must be removed from columns by mechanical methods.

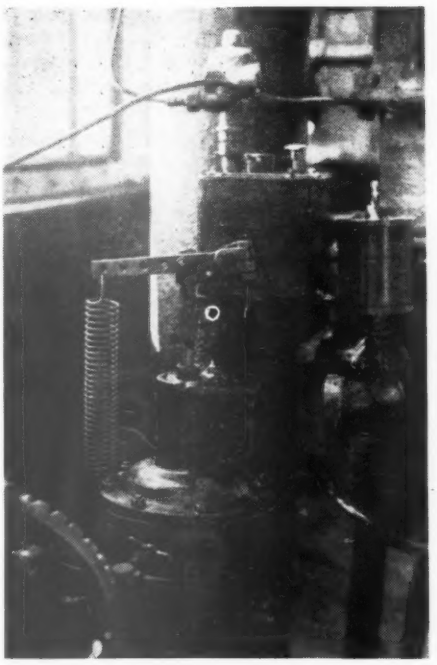
Synthetic Fuel

An industry program for the synthesis of a million barrels of synthetic hydrocarbon fuels daily will cost the nation $8,700,000,000 for mines, plants, and pipe lines, J. D. Doherty, assistant chief of the Office of Synthetic Liquid Fuels to the mining and mechanical engineers at White Sulphur Springs, West Virginia, at their joint meeting November 3. This plan will require 575,000 tons per calendar day, or 210,000,000 tons per year, Doherty said. Cost per gallon of liquid product would be about 12.5 cents, the estimate was given.

PLANT AIDS

Air Operated Force Feed Lubricator

WHEN forced feed lubrication is necessary on a locomotive type air compressor, the oil can be fed to the moving parts with an attachment made from salvaged parts of other equipment. The diaphragm head of a controller is mounted on a suitable bracket attached to the post which carries the compressor, in a position so the conventional force feed lubricator can be installed directly above the end of the shaft connected to the diaphragm, and connected with a clevis to actuating arm of lubricator.



A convenient length of copper tubing is attached to a fitting on the compressor and to the center opening of the diaphragm case. In the length of tubing is placed a needle valve to control the quantity of compressed air through the tubing into the chamber of the diaphragm. Into the tee fitting attached to the diaphragm case is a nipple carrying a pinch valve to bleed air from the diaphragm between strokes of the compressor. A helical spring attached to the diaphragm case and the outer end of the lubricator lever returns the stroke of the valve between pulsations of the compressor.

On the compression stroke air is forced through the tubing to the diaphragm, forcing the stem upward and moving the actuating lever of the lubricator. On the down stroke, the air bleeds from the pinch valve so the return spring brings the arm of the lubricator down for another stroke. The length of the stroke can be adjusted readily by the volume of air passing through the needle valve and being bled through the pinch valve after a little experimentation.

Cracking Furnace Tube-Header Truck

AN ingenious device is made, to carry reconditioned tube-headers from the shop to the unit so the equipment will be protected from damage and the polished ends kept clean. Upon a more or less conventional trailer frame is built a rack made of angle iron with each end in the shape of a house-roof gable. Four straps of heavy steel are welded to each side of the 'roof' as wide spaced sheeting containing nipples so that each header will be supported with two nipples, one for each end. Each nipple is made of pipe of a size to enter the return bend opening and long enough to keep the header securely in place when the trailer is towed from the shop to the unit where the equipment is to be used.

Light Important Factor

MANY so-called "successful business men" seem to have peculiar notions about efficient lighting methods. The writer has noticed this many times in journeying about from town to city and calling upon various business institutions as well as on his friends and acquaintances. Perhaps you too have noticed it but haven't thought about the poor light men often provide for themselves and their help as well. The writer has found. for instance, that it is common practice for an executive to use a single little desk lamp of insufficient power for lighting his work. The lamp is usually cheap, in appearance and price. Cheapness often seems to be a part of men's efficiency ideas, and so they call a higher-priced lamp a luxury and out of place in the business world. Workmen are compelled to labor under the same conditions and thereby a considerable saving is made in the matter of first cost of lamps.

It is common for these "higher ups" to work under their poor lights from eight to ten hours per day, and their eyes become tired. Yet, just as soon as these men get home they insist on entirely different lighting. At home they want the best. Reading the paper at night they complain about the merest shadow. They are surrounded by the best that can be had, but with tired, overworked eyes they cannot make full and comfortable use of the good light at home and so simply sit around, smoke, talk, and retire early. These men use their "good" lamps about two or three hours per day and their "poor" light from eight to ten hours per day and often more.

From an economy viewpoint it may be all right to give a workroom a plain barn-like appearance in order to enjoy home life all the more. But the five senses should be protected and cared for as well in one place as in the other. If you of your employes are miserable during working hours, due to poor light or any other cause, you can be sure that production will suffer. And if one is miserable during the day it isn't easy to become happy of a sudden over night.

Light is an important subject and it should be given more attention than has been given it in connection with production. It is well worth considering carefully from a purely economic viewpoint. From that point of view it will invariably be found that not one of these four senses of the employer or employe should ever be allowed to suffer unnecessarily—seeing, feeling, hearing, and smelling. The other sense—taste—is generally "up to the individual himself." Good light, proper temperature, minimum noise, and absence of sickly or irritating odors are all important economy factors. ★

PLANT AIDS

Thickness of Leather Belting for Oil Plants

SIMPLY because a leather belt is thinner in one spot than in another is not conclusive proof that the belt is of varying strength throughout its length. The strength of a leather belt depends almost entirely on the place it occupied in the animal's hide. Tannage is important also, because superior tannage gives belting greater strength, toughness, life, etc.

Recent examination of the report of a tester who tested strips of belt one inch wide from the various parts of the steer's hide shows plainly that the thicker the hide, usually, the weaker the belt per square inch of sectional area. The thinnest specimen, from the back section of the hide, is the strongest per square inch while hide from the neck portion has the lowest unit strength.

This surely proves that it is not absolutely necessary to make the belt of uniform thickness, as is sometimes argued, except to make it run more smoothly, to make it "look" better, or to make it more mechanical in every way. A belt may be of variable thickness from end to end, and yet possess the same total strength of any given section.

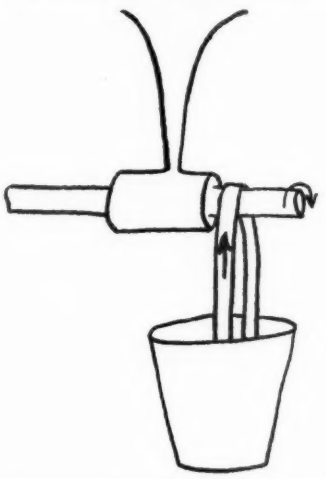
Of course, where the leather is taken from the choice part of the hide, as it should be, the cross-sectional strength is virtually constant and the belt would really be benefited by shaving down to uniform thickness. The thought here is merely to point out the fact that leather belting strength depends primarily upon the section of the hide from which it is taken.

The above also explains why, in the making up of high grade double leather belts, it is possible to so match the overlapping plies that thin sections adjoin thick sections, thus producing a belt of ideally uniform thickness and uniform strength. ★★★

How to Cool a Bearing With Water

THE sketch herewith shows an excellent method to keep hot bearing cool and keep things going without shutting down when conditions allow. An endless belt is placed on the shaft close to the hot bearing and is allowed to hang down into the pail of cold water as shown. As the shaft rotates it causes the saturated belt to move upward onto the shaft thereby keeping the shaft wet and cool and enabling it to absorb heat from the bearing. Any flexible belt that absorbs water readily will serve the purpose. The belt should be kept as close to the hot bearing as possible. With this method there is no splashing of water and there is no mixing of the water with the lubricant.

Further, the illustrated method is preferable to cooling the hot bearing outside because, when a bearing is hot all parts are expanded—the inside as well as the outside. Therefore if the outside is cooled first it may reduce in size sufficiently to seize the shaft and end in disaster. With this method the shaft is cooled first, which obviously is the more logical way. ★★★



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PERSONALS

▸ **Otto Koch,** chairman of the Board of Directors of Kendall Refining Company and leading figure in Pennsylvania refining circles for more than 40 years, died October 12, in his 83rd year. Koch became associated with Kendall Refining Company in 1906. He was prominent in the counsels and activities of the Pennsylvania Grade Crude Oil Association and the National Petroleum Association. His company is known nationally for its lubricating oil manufacture and distribution, and is the last surviving plant of several which operated formerly at Bradford.

M. C. Hagar has accepted the position of general purchasing agent for the National Cooperative Refinery Association, with headquarters at the home offices of the company at McPherson, Kansas. Hagar was recently with the Sinclair organization, and will organize the purchasing department of the Cooperative, a new venture for that company.

▸ **John D. Fleming,** 58, of the organic sales department of Monsanto Chemical Company, died of heart attack in St. Louis October 12. He had been with Monsanto since 1934.

▸ **Ben G. Symon,** lubricants department manager for Shell Oil Company in New York, was elected president of the National Lubricating Grease Institute at its annual meeting in Chi-

Ben G. Symon

cago in October. New vice president of the NLGI is **A. J. Daniel,** Battenfield Grease and Oil Corporation; treasurer, **E. V. Moncrief,** Swann-Finch Oil Corporation and executive secretary, **H. F. Bennetts.**

▸ **Harry Kuhe** has been appointed manager of the chemical sales division of Ethyl Corporation, and will have charge of all chemical sales except anti-knock compound. Kuhe joined Ethyl 19 years ago, in the Chicago division, was made assistant manager of the Tulsa division; went to Mexico for a year in 1938 as sales representative, to Seattle as division manager in 1940, then was made division manager at Chicago in 1946. He became operations manager of the Central region in 1947. The chemical products under his jurisdiction at present are salt cake, or sodium sulphate, metallic sodium, liquid chlorine, ethylene dichloride, oil-soluble dyes and, recently added, benzene hexachloride, an insecticide. **Leonard L. Huxtable,** formerly sales coordinater of the Southern region, has been made operations manager of the Central region, with Chicago offices.

▸ **A. G. Koenig** was appointed general sales manager for C. J. Tagliabue Corporation, and **G. A. Terhune** was made advertising manager of that company, E. R. Mellen, president of the Tagliabue and its parent, Weston Electric Instrument, announced.

▸ **Dr. Norris D. Embree** has been appointed research director at Distillation Products, Inc., subsidiary of Eastman Kodak Corporation, Raymond W. Albright, general manager of the plant, announces. Embree was born in Wyoming in 1911, educated at the University of Wyoming and at Yale (Ph. D., 1934) in chemistry.

▸ **Otto L. Schweng** has been appointed director of market research for Diamond Alkali Company, President Raymond F. Evans announced, and his headquarters will be at 570 Lexington Avenue, New York. For four years Schweng has been economic specialist with the development department of General Aniline and Film Corporation, New York. He has been connected with the chemical industry since 1930, serving as chief analyst of investments in chemical and allied industries for Lehman Corporation and in the War Production Board with A. H. Bunker, prior to joining General Aniline.

▸ **Ronald B. Smith,** engineering expert of long experience, has joined the staff of M. W. Kellogg Company, President H. R. Austin announces. His special fields include gas turbines, superchargers, oxygen plants, and

Ronald B. Smith

power machinery generally. He is a member of several engineering and technical organizations, is consultant to the Atomic Energy Commission and adviser to the National Advisory Committee for Aeronautics.

▸ **Dr. G. E. F. Lundell,** chief of the chemistry division of the U. S. Bureau of Standards, has retired from that position, to remain as consultant to the division. **Dr. Edward Wichers,** former assistant chief, has been elevated to the chief's post, succeeding Dr. Lundell. **Dr. William Blum** has been made assistant chief. Dr. Lundell was born in Brooklyn, New York, in 1881, received the doctor's degree from Cornell in 1909, also an honorary D. Sc. from Fordham in 1941. He joined the Bureau in 1917, became chemistry division chief in 1937. He is known widely in scientific circles in this country and abroad, is quite active in several scientific socie-

G. E. Lundell

ties, including the American Chemical Society, Washington Academy of Sciences, American Ceramics Society and the American Society for Testing Materials. He received the Hillebrand prize for chemistry in 1932.

▸ **Harry K. Collins** has been appointed manager of the plastics division, chemical department of General Electric Company, and **John L. McMurphy,** manager of the chemicals division of the same company. Collins will be responsible for product engineering, manufacturing, sales and accounting for several products including laminated, molded, and fabricated plastics. McMurphy will be in charge of glyptal alkyd resins, varnishes, paints, silicones, etc. McMurphy's assistants will be **C. Stewart Ferguson,** engineering manager; **John A. Zellhoefer,** sales manager; **Robert A. Rieker,** accountant; and **E. T. Kilgore,** assistant on silicones. Aiding Collins will be **Frank W. Warner,** engineering manager; **Donald S. McKenzie,** sales manager; **Elmer H. Gabel,** accountant. with **Arthur C. Treece** assistant on laminated products.

Robert L. Gibson has been promoted from manager of the plastics division to assistant general manager of the chemical department. Gibson came to General Electric in 1925. and has been in publicity, market research. advertising, broadcasting, and manager of the personnel division. **Dr. Charles E. Reed** is now engineering manager of the chemical department.

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▸ **Henry D. Noll** has been made manager of Houdry Process Corporation's engineering and technical service division, Brig. Gen. D. N. Hauseman, Houdry president, has announced. Noll is widely known in the refining industry and has very extensive experience in refining technical and development circles. His department will be interested principally in aiding Houdry licensees to operate their processes more efficiently. Noll spent many years with Standard Oil Company of New York, Magnolia Petroleum Company, and Socony-Vacuum Oil Company's Paulsboro research and development department. Noll will operate under Dr. C. C. Peavy, vice president in charge of engineering and sales.

Henry D. Noll

▸ **B. Brewster Jennings,** president of Socony-Vacuum Oil Inc., was principal speaker at the annual dinner of the Boston members of Socony's 20-year Club dinner October 22, at which more than 1000 long term members of that company's staff participated. At the New York dinner, nearly 1200 attended, addressed by **Geo. V. Holton,** chairman of Socony's board of directors. Thirteen other similar dinners were held in Milwaukee, Pittsburgh, Philadelphia, Buffalo, Kansas City, Wichita, Kansas, Minneapolis. Omaha, Detroit, Chicago, St. Louis, Casper, Wyoming, and Aberdeen. South Dakota.

After holding the post of secretary of the American Institute of Mining and Metallurgical Engineers for 18 years, **Dr. A. B. Parsons** has resigned effective February 1, 1949. Dr. Parsons has been on leave of absence now for some time.

▸ **John E. Weber** has been made manager of the planning department of the Catalytic Construction Corporation, a subsidiary of the Houdry Process Corporation of Philadelphia.

NEWS

New refinery at Camden, N. J.

Contract for the construction of a large office and administrative building at the site of its new refinery near Camden has been let by The Texas Company to Turner Construction Company. The building will be erected at Eagle Point, seven miles south of Camden on the Delaware River. The building is T-shaped, and will be one, three, and four stories in height. It will be built of reinforced concrete with brick facing and will be 43 ft by 180 ft, with a wing 43 ft by 130 ft. Construction has begun and the building is expected to be completed by April, 1949. The Texas Company some time ago acquired a 1300-acre tract on which to build a new refinery.

Lion Building Two Plants

Sulphuric acid and ammonium sulphate plants will be built by Lion Oil Company's chemicals division, T. M. Martin, Lion president, announces. The acid plant will produce 300 tons per day of sulphuric acid, from 100 tons of sulphur burned daily, will cost $1,250,000, Martin said. The ammonium sulphate plant, fertilizer, will cost about $750,000 and will make 380 tons per day of this important product.

The plants will be built in connection with existing ammonia and other chemical facilities near El Dorado, Arkansas; design is 75 per cent complete (November 1), and buying of equipment is 50 per cent completed or more. September 1, 1949 is the planned completion date for the units.

O. U. Fellowships

Chemical Engineering Fellowship has been awarded the University of Oklahoma School of Chemical Engineering, Dr. Wayne E. Kuhn, manager of technical and research division of The Texas Company, announces. The work will be under the direction of Dr. R. L. Huntington, chairman of the school, and will carry out research on the behavior of fluid catalysts, on problems dealing with heat transfer in various chemical and petroleum processes.

Cracking Capacity Doubles

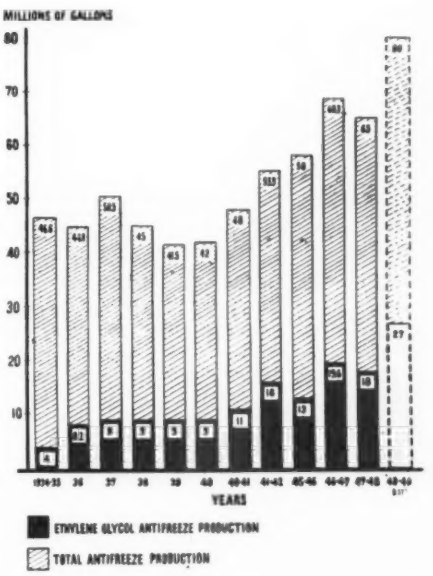
U. S. refining capacity is reported to be 6,034,252 bbl per day as of January 1, 1948, according to the recently released report of the U. S. Bureau of Mines, or nearly a half-million bbl per day more than for the previous year. Cracking capacity increased about 110,000 bbl per day, of which about 75 per cent was catalytic capacity. New cracking capacity under construction at the first of the year totaled 172,000 bbl, or more than twice that of January 1, 1947. The major portion of the total crude capacity came as result of changes and revamping of existing units to increase throughput.

Sinclair Opens Laboratories at Harvey, Illinois

The Sinclair research and development laboratories at Harvey, Illinois were opened with a celebration on October 22; the laboratories cost "several million dollars," it was stated. This is part of the company's $150,000,000 expansion program, involving all departments, it is understood. Nine buildings with 215,000 sq ft of floor space cover 20 of the 38 acres in the site.

The unit is 12 miles from Sinclair's East Chicago refinery at the intersection of Sibley Boulevard and the I. C. Railroad line. The department will include 400 scientific and administrative employes. The buildings include the administration building, main laboratory, pilot plant building, engine laboratory building, fuel application laboratory, exploratory research laboratory, lube building, first aid-clockhouse building, shops, boiler house and storehouse.

Maintenance to Administration Building of Sinclair Laboratories.



***New Anti-Freeze Made** and marketed by The Texas Company, it is announced. It is named Texaco PT Anti-freeze and its main ingredient is ethylene glycol, a high-boiling 'permanent' type of anti-freeze. The product is made by Jefferson Chemical Company, Port Neches, Texas, subsidiary of The Texas Company, and American Cynamid Company.*

Extend Methane Research

Studies and research methods about natural methane in Italy are presided over by the Ente Nazionale Metano. created in 1941, that has just this year increased its capital to 400,000,000 lire, owing to government aid.

From the beginning of this year the Ente is managed by an Extraordinary Commissary, Alfredo Scaglione, lawyer. The general manager is still Engineer Mariano Amico.

To these two authorities now belongs the task of reorganizing the Institute, to drop control of the production and distribution of the Methane gas and extend its activity in the discovery and exploration of methane sources by increasing geophysics and geological research.

To this end, the Ente employs personnel of the geological office in Bologna and some French technicians, which have come to the northern Italy zone for the work.

Gasoline Plant in Operation

Natural gasoline plant of Texas Natural Gasoline Corporation near Abilene, Texas, started operations late in October. The plant can process 4,500,000 cu ft of gas daily and is characterized by the absence of steam boilers, and by the use of light hydrocarbon gases for stripping purposes. L. A. Boyd is in general charge of the operation.

NEWS

Petroleum Being Synthesized by Nature

Petroleum hydrocarbons are being synthesized drop by drop by the small animals—polypi—which form coral reefs, Dr. Werner Bergman of Yale University told the Northeastern American Chemical Society section at its recent meeting at MIT. The coral material forming reefs contains one-seventh of one per cent of a waxy material similar to petroleum heavy products, Bergman stated. The fats of sea-dwelling animals contain a large percentage of unsaponificable fats and many types of sterols, mainly cholesterol. Study of the fats formed by sea animals is extending the knowledge of these products.

Graduate Fellowship

A graduate research fellowship has been awarded to Lehigh University by Socony-Vacuum Oil Company, Inc., which is valued at $2000. This is one of 13 such fellowships given by the company to different colleges. It is in the department of chemistry and chemical engineering, to carry on investigations in instrumental analysis under the direction of Dr. E. J. Serfass, chemistry professor at Lehigh.

Plans Two Topping Units

Construction of two topping units, to total 50,000 bbl per day capacity will begin soon at Texas City, Texas, for the Petrol Refining Company, Inc. Rust Engineering Company of Pittsburgh, Pennsylvania has the contract for this work for both design and construction. The units will produce a number of straightrun fractions as well as charge stock for the Houdry catalytic cracking unit already in the plant. Equipment will be used from a toluene concentration plant bought from WAA.

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Refinery for Sale

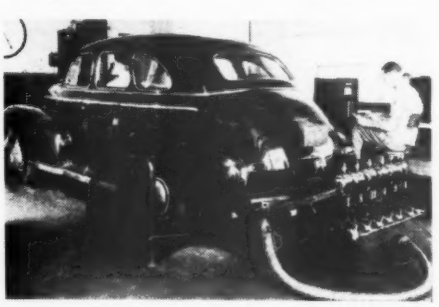
War surplus refinery near Shreveport, Louisiana, operated by Premier Refining Company at Cotton Valley, Louisiana, is offered for sale by War Assets Administration. It cost more than $4,000,000 when built in 1944, is on a 31-acre plot, was designed to make aviation gasoline. Information regarding the plant may be obtained from Office of Real Property Disposal, WAA, P. O. Box 6030, Dallas, Texas.

Refiners Run 5,621,000 Bbl Crude Daily

American refiners ran to stills 5,621,000 bbl of crude daily during August, 1948, Bureau of Mines reports show. Foreign crude was imported at the rate of 351,000 bbl daily average, or 85,000 bbl daily higher than a year ago. Domestic crude receipts increased 22,000 bbl daily over the July figures.

Texaco Tests New Car Models

Testing of 1949 car models is under way at The Texas Company's Beacon, New York laboratory, employing a unique chassis dynamometer assembly whereby road conditions are reproduced within the walls of the laboratory and better results are obtained than could be collected by a fleet of cars operating on the public highways. Purpose of the tests is to determine



performance of each engine and car, to find out the types of gasoline and lubricating oil which perform best in each engine, and to gain any other information which will be used by the company's manufacturing division in producing fuels and lubricants "tailored" to the cars' requirements.

Silicone Useful

Silicone products such as oils, greases, rubber, etc., are becoming increasingly important in industry. In these products silicon, one of the earth's most common elements, takes the place of carbon in a measure and one type of product is called polyorganohalogenopolysiloxanes. The products have wide usage, especially for waterproof films, insulation for electrical equipment, etc.

Cold Engine Operation Causes Most Corrosion

Corrosion of engine parts is traceable mainly to cold operation, Shell Oil scientists state. Up to 90 per cent of engine wears is caused by the products of incomplete combustion of fuel which results from intermittent "on and off" operation of cars, permitting partly burned fuel, and water, to attack smoothly polished surfaces, C. E. Davis, vice president of Shell for refining east of the Rockies states. These conclusions were arrived at after hundreds of thousands of miles of test operation, in the course of studies on oil additives to prevent or minimize this corrosion. Results of this work are the placing on the market of a new oil containing Perma-16, an additive which includes detergent, antiwear agent and an anti-oxidation component, which will be marketed under the Shell X-100 brand.

Catalysis symposium

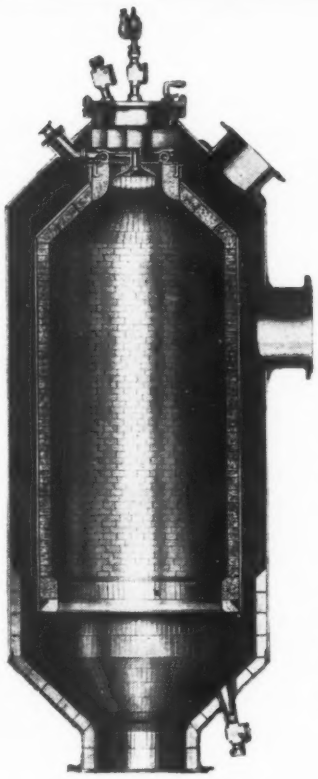
The so-called fluid principle of catalytic operations is to be emphasized in the 15th Annual Chemical Engineering Symposium sponsored by the Division of Industrial and Engineering Chemistry of the American Chemical Society, to be held at Massachusetts Institute of Technology on December 28-29, 1948. The Symposium is announced by Division chairman, Joseph C. Elgin of Princeton University, and is under the direction of Dr. Milton T. Work of Metal and Thermit Corporation.

Application of this principle of finely divided solid particles suspended in a stream of gas or vapors has been successful in a large number of installations for cracking petroleum oils, catalytically, units now operating throughout the industry. Leaders in applied science in industry are certain that this technique will prove equally important in the gasification of coal and the synthesis of hydrocarbons from solid or gaseous raw materials. Dr. E. W. Thiele, Standard Oil Company (Indiana) is chairman of the technical papers subcommittee.

Chemical Firm Organized

Indoil Chemical Company, wholly-owned subsidiary of Standard Oil Company (Indiana) is announced by that company, with W. B. Plummer as president. Dr. R. C. Gunness is vice president, and H. R. Peterson will be sales manager. Plummer has been manager and Peterson sales manager of Indiana's chemical products department. Two new products will be added to the company's line, Alkanesulphonic acid, interesting as a catalyst and for other purposes; and nonyl alcohol, plasticizer derivatives base.

PEABODY



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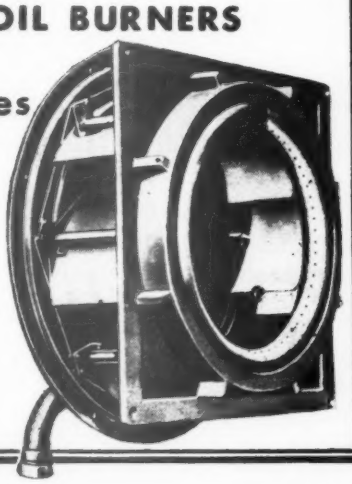

Either gas or oil may be burned alone or simultaneously in these burners. Complete control of flame characteristics by perfect air-flow, fuel-flow, and fuel-air mixing principles offers dependable and economical operation. Gas ring can be removed while burner is in operation.

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REFINING CAPACITY AND AVERAGE CRUDE OIL RUN TO STILLS IN THE UNITED STATES

From The Petroleum Data Book, Second Edition, which carries 750 pages of information on the petroleum industry.

(Thousands of Barrels Daily)

Year	Crude production	Crude imports	Total supply	Refinery runs	Assumed average operating capacity	Daily refining capacity as of January 1				Number refining units as of January 1				Refinery runs per cent of average operating capacity
						Operating	Shut-down	Building	Total	Operating	Shut-down	Building	Total	
1918	975	103	1,078	893	1,240	1,186	—	—	—	—	—	—	—	72
1919	1,037	145	1,182	990	1,415	1,295	—	—	—	—	—	—	289	70
1920	1,210	290	1,500	1,186	1,665	1,531	—	264	—	373	*	99	472	71
1921	1,294	343	1,637	1,215	1,825	1,794	94	77	1,965	350	65	44	459	67
1922	1,527	349	1,876	1,372	1,965	1,855	255	60	2,170	325	154	30	509	70
1923	2,007	225	2,232	1,592	2,185	2,075	—	—	—	—	—	—	—	73
1924	1,951	212	2,163	1,759	2,395	2,300	—	—	—	—	—	—	—	73
1925	2,092	169	2,261	2,027	2,525	2,490	338	37	2,865	357	184	6	547	80
1926	2,112	165	2,277	2,135	2,700	2,562	291	6	2,859	352	158	2	512	79
1927	2,469	160	2,629	2,271	2,935	2,834	227	61	3,122	327	138	7	472	77
1928	2,463	218	2,681	2,495	3,180	3,036	214	22	3,272	326	97	5	428	78
1929	2,760	216	2,976	2,706	3,480	3,326	184	99	3,609	341	72	14	427	78
1930	2,460	170	2,630	2,541	3,670	3,635	131	37	3,803	358	54	8	420	69
1931	2,332	129	2,461	2,451	3,665	3,707	236	45	3,988	346	89	10	445	69
1932	2,145	122	2,267	2,240	3,535	3,625	390	9	4,024	365	108	6	479	63
1933	2,481	87	2,568	2,360	3,500	3,445	444	32	3,921	372	133	18	523	67
1934	2,488	97	2,585	2,454	3,585	3,554	365	44	3,963	454	137	13	604	68
1935	2,730	88	2,818	2,646	3,680	3,615	444	14	4,073	435	196	7	638	72
1936	3,005	88	3,093	2,920	3,860	3,750	367	47	4,164	422	210	15	647	76
1937	3,506	75	3,580	3,242	3,970	3,967	328	81	4,376	423	149	11	583	82
1938	3,327	72	3,399	3,192	3,950	3,970	381†	283†	4,634	431	120	10	561	81
1939	3,466	91	3,557	3,391	4,065	3,934	575	142	4,651	435	103	7	545	83
1940	3,697	117	3,814	3,536	4,190	4,197	432	92	4,721	461	86	10	557	84
1941	3,842	139	3,981	3,861	4,340	4,181	538	141	4,860	420	136	6	562	89
1942	3,799	34	3,833	3,655	4,490	4,497	460	43	5,000	430	92	1	523	81
1943	4,125	38	4,163	3,917	4,500	4,409	493	195	5,097	386	85	1	472	87
1944	4,584	122	4,707	4,551	4,920	4,709	384	118	5,211	384	68	—	452	93
1945	4,695	204	4,899	4,711	5,230	5,100 (E)	280 (E)	65 (E)	5,445 (E)	395 (E)	50 (E)	—	445 (E)	90
1946	4,750	236	4,986	4,740	5,320	5,260 (E)	180 (E)	80 (E)	5,520 (E)	408 (E)	31 (E)	—	439 (E)	89
1947 (P)	5,085	267	5,352	5,075	5,500	5,307	233	162	5,732	361	38	—	399	92

(P) Estimated by *The Petroleum Data Book* Research Department.

Source: U. S. Bureau of Mines

*Shut-down plants included under operating.

(P) Preliminary.

†Beginning with 1938 shut-down capacity includes inoperative portions of operating plants as well as capacity of plants completely shut-down. Building capacity includes construction at existing plants as well as construction of completely new plants.

Note. See 1948 Survey of refineries in this section of *The Petroleum Data Book*.

NO TANKER SHORTAGE

Although a tanker transportation shortage prevailed during the last peak demand (the winter months of 1947-48), no such shortage is expected in the peak demand months just ahead. Several factors have entered into bringing about this change in the situation. A year ago a transition was being made of the war-built tanker fleet from government to private ownership. This factor immobilized approximately 100 T-2 tankers and 37 of the Liberty type vessels. In addition to the ships thus tied up, considerable tonnage was wasted due to a lack of efficiency of those vessels operated by the government. This lack of efficiency is considered unavoidable, and carries no stigma, being brought about by the fact that the government does not have the continuity of business that private owners do, which makes it possible for the latter to avoid cross-hauls, loading and discharge delays, and other factors that detract from the effective use of tonnage. A third factor is new construction. In all, it is estimated by the National Petroleum Council's Committee on Petroleum Tanker Transportation that 171 more T-2 equivalent tankers will be available by the latter part of the year than were available during the winter of 1947-48. This estimate breaks down as follows: 100 T-2s from laid-up status; 19 equivalent T-2s from laid-up status (37 Liberty ships); 30 due to increased efficiency under private ownership, and 22 from new construction.

A number of factors makes it difficult to forecast the adequacy of the world's tanker fleet over a long period; however, authorities seem agreed that for the next 12 months at least tanker tonnage and demand will be in balance.

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Laying 12-in. line from Elk Basin to Thermopolis. *Standard Oil Jersey Photo.*

Wyoming Pipe Lines Meet Production Demands

By IRVING GARBUTT

EVERY 24 hours a "silent trainload" of gasoline, lubricants, and other refined products slips out of Casper, Wyoming, to the larger marketing area centered in Denver. It moves through the new Wyco products pipe line, placed in operation early this year.

The average resident of this fast-growing "oil capital of the Rockies" does not realize the economic importance of this 267-mile 8-in. artery, which in effect places Casper refineries at Denver's door, yet retains payrolls and taxable values in the community.

The products pipe line is the key to the multimillion dollar expansion and modernization program now nearing completion at Casper's three refineries. An estimated $50,000,000 will have been spent to install catalytic cracking units and other equipment at the Texas, Socony-Vacuum, and Standard of Indiana plants in and adjacent to Casper.

Texas completed its new cracking unit early this year. Standard expects to complete remodeling its 15,000-bbl plant early next year. Socony-Vac-

EXCLUSIVE

uum's remodeling work is in an advanced state.

Products from all three refineries flow through the new pipe line to Cheyenne and Denver. The initial fill of 100,000 bbl was made by Standard, holder of the majority interest in the line, last January. Since then the line has been moving about 17,000 bbl of refined products daily from all three refineries. Formerly most of the products were hauled by trucks from Casper to Denver.

New refinery construction in Casper, Billings, and Salt Lake City is expected to provide processing for practically all of the crude produced in the Rocky mountain region within the next six months.

At Billings, Carter Oil Company expects to complete its new 22,000-bbl refinery early next year. Continental is completing another 8000-bbl plant in Billings. In Salt Lake City the Standard Oil of California is nearing completion of its new refinery which will handle crude from Colorado's Rangely field through the new 10-in. pipe line just recently completed. Utah Oil Refining Company has announced new construction at its 25,000-bbl Salt Lake City plant.

Refinery capacity in the Rocky Mountain region is expected to rise to a maximum of 220,000 bbl of crude daily, leaving only about 15,000 bbl to be transported to other refining areas—unless development and exploratory drilling increases the crude supply sharply in the future.

The refining industry in Casper is also stabilized by pipe lines bringing in crude from widely separated fields in the state. Socony-Vacuum is preparing to run 135 miles of 8-in. line from its new Sand Creek field in Washakie County to the Casper refinery. A gathering system is being completed in the field before several wells are placed on production.

During the past year the Stanolind pipe line from Wyoming to the Kansas City area has been reconditioned through eastern Wyoming and Nebraska. The 16-in. line between Clayton tank farm near Douglas to Glendo, a distance of 35 miles, has been replaced. Another 25 miles of 12-in. line was replaced between Glendo and Guernsey, and spotted replacements were made in the 100 miles of 16-in. from Guernsey to a point in Nebraska.

Completion of this construction enables Stanolind to ship additional crude eastward from Wyoming and Colorado fields.

Stanolind also laid a line from Wamsutter, in Sweetwater County, to Sinclair's station three miles east of the Mahoney Dome field, where a connection was made for shipment of oil via the Sinclair line into Casper. This enabled shipment of Rangely, Colorado, oil into Casper's three refineries.

The capacity of lines from fields in the Wind River Basin to Casper was also increased during the year.

Recently Sinclair-Wyoming Oil Company discontinued shipment of about 8000 bbl of Rocky Mountain crude from its refinery at Sinclair (Parco) to Kansas City, due to the closing of the Kansas City refinery. This has decreased the need for additional crude from Sinclair's Wyoming fields, notably Lost Soldier, where three rigs have been running this year. There is some speculation that the termination of the tank car shipments may slow the development program at Lost Soldier.

Several other shorter feeder lines have been built during the year, such as Ohio Oil Company's 14 miles of 4-in. line from the Hatfield Dome field in Carbon County to Sinclair, and U. S. Oil and Development's 7-mile gas pipe line from the new Pine Mountain gas field in Natrona County connecting with Northern Utilities' main Sand Draw-Casper gas line serving communities in the North Platte Valley of Wyoming and Nebraska.

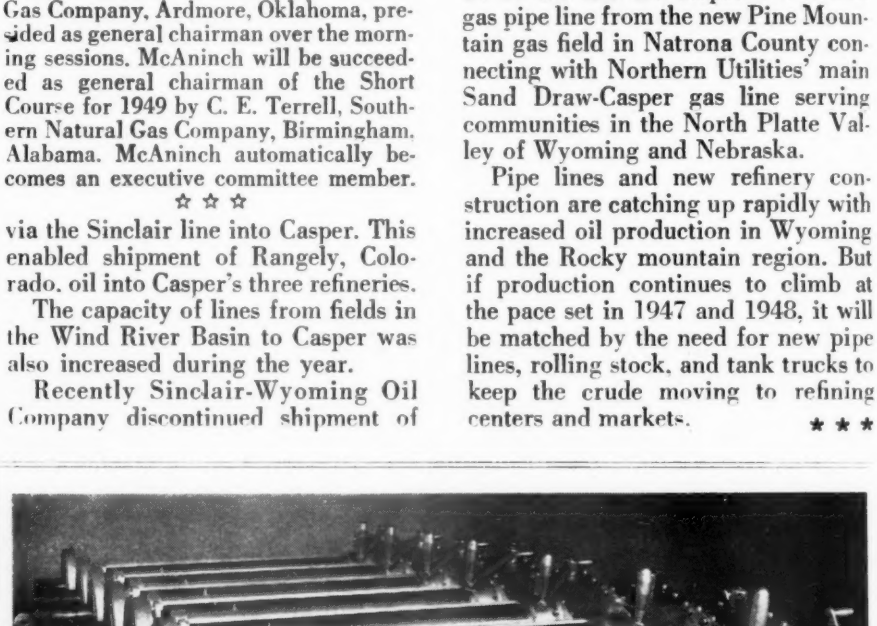
Pipe lines and new refinery construction are catching up rapidly with increased oil production in Wyoming and the Rocky mountain region. But if production continues to climb at the pace set in 1947 and 1948, it will be matched by the need for new pipe lines, rolling stock, and tank trucks to keep the crude moving to refining centers and markets. ★ ★ ★

Short course dates

The general committee of the Southwestern Gas Measurement Short Course has announced that the 1949 course will be held on April 12, 13, and 14. This Short Course is an annual event on the calendar of the College of Engineering, University of Oklahoma, Norman, Oklahoma. The educational features of the course and the enrollment have grown until approximately 65 instructors are required to give the special lectures and teach the classes. This year, 841 men from the industry, representing 29 states and one foreign country, attended. In addition to these enrollees, approximately 350 college students attended one or more of the classes.

E. C. McAninch, Oklahoma Natural Gas Company, Ardmore, Oklahoma, presided as general chairman over the morning sessions. McAninch will be succeeded as general chairman of the Short Course for 1949 by C. E. Terrell, Southern Natural Gas Company, Birmingham, Alabama. McAninch automatically becomes an executive committee member.

☆ ☆ ☆



THE Hillco PIPE TAPPING MACHINE*

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THE PIG WITH THE POKE CLEANS PIPE LINES

T. D. Williamson, Inc.
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*Patent No. 2,097,398
Other Patents Pending

Tapping Machine Aids in Draining Pipe Line*

By A. M. HILL†

In the maintenance and repair of large oil pipe line systems, and petroleum products pipe lines, it is frequently necessary to drain the lines for replacing sections of defective pipe in which leaks have developed due to soil corrosion and from other causes. These pipe replacements are usually made at creek and river crossings, and low areas where corrosion is most severe and, in many instances, it is necessary to evacuate pipe lines to re-locate sections of lines to correspond with new highway construction, railroad improvements, dams, irrigation projects, and drainage canals. When new lines, or pipe line loops, are laid parallel with existing lines to increase pumping capacities, certain sections of the pipe line system must be evacuated for connecting the new facilities. Portable pumping units are used for evacuating pipe lines, and tapping machines are used for drilling openings into pipe lines through special tapping nipples, which are welded to the pipe line to provide a means of connecting the pumping units for transferring the oil or petroleum products into a parallel pipe line, or around a gate valve placed in the pipe line to facilitate draining.

Arc welding is universally used in the construction, maintenance, and repair of pipe lines. It is also used exclusively in the fabrication of special equipment that greatly facilitates the maintenance of pipe lines. The tapping machines described in this paper have developed into very useful tools, and exemplify the economics made possible by arc welding.

The P & H pipe tapping and plugging machine, also the tapping nipple and plug, were invented and designed by the author and J. E. Polston, a field superintendent for Stanolind Pipe Line Company. This equipment was developed and built in the shops of the Stanolind Pipe Line Company, and has been used exclusively throughout its system for the last 11 years in connection with the maintenance and repair of pipe lines. The author has engineered, designed, and developed two improved models with automatic feed mechanism. The current model, now manufactured under the name of Hillco, will be described in detail and is shown by photograph.

The original machine was manually operated with a ratchet lever and hand-wheel feed. The hand-operated feed mechanism has a tendency to crowd the cutting tool when it penetrates the inner wall of the pipe, and failure of the cutting tool frequently occurs unless it is fed slowly as the drilling operation progresses. Frequent breakage of the cutting tool has caused many delays and much extra work at times when the pipe line system was shut down for making line repairs, or connecting new facilities. These faults were due to characteristics of the hand-feed mechanism, and have been overcome by numerous improvements in the newly designed machines.

The principal improvements are:

1. A worm gear drive that may be operated with a hand crank, or by mechanical power.

2. Telescopic boring bar and feed screw that have sufficient travel for use with all types of high pressure gate valves.

3. An automatic feed mechanism designed to feed the cutting tool into the pipe in direct proportion to the revolutions of the hand crank.

The improved machine with automatic feed has greatly facilitated the drilling operation and has eliminated breakage of the shell cutter.

The telescopic principle permits a very compact unit having 30-in. of boring bar travel, and the overall length is 48¾-in. Machines of this type are suitable for all drilling and plugging operations on crude oil pipe lines, petroleum product pipe lines, natural and artificial gas pipe lines, also water pipe lines that are constructed of steel pipe; in fact, any pipe line or vessel to which a tapping nipple can be arc welded may be drilled and the opening plugged with this machine.

There are three sizes, designated as:

Model 200 for drilling openings from 1-in. to 2-7/16-in. diam has 22-in. travel on boring bar.

Model 600 for drilling openings size 2-7/16-in., 3-7/16-in., and 5-9/16-in. diam has 30-in. travel on boring bar.

Model 1200 for drilling openings through 8-in., 10-in., 12-in., 14-in., and 16-in. high pressure gate valves, has 45-in. travel on boring bar.

These three machines cover the range of drilling holes from 1-in. to 14-½-in. diam.

The special tapping nipples, size 1-½ to 4-in. (used in conjunction with the tapping machine), are threaded internally for a special plug, and externally for a pipe coupling and bull plug. The flanged type tapping nipples, 3-in. and larger, have an internal thread for the plug and may be equipped with standard slipon flanges, ASA 150 to 900, depending on the type of gate valve required for pipe line operations.

The procedure for operating Model 600 tapping machine for drilling operation is as follows:

1. Preparatory to welding a tapping nipple onto the pipe line to be tapped, a suitable gate valve (with ample clearance through seat rings for passage of shell cutter and the special plug) must be used in conjunction with the tapping machine.

2. A tapping nipple corresponding to the type and size of valve is scarfed or saddled to fit the pipe, and arc welded to the pipe line.

3. The gate valve is then installed on tapping nipple.

4. A special adapter is then installed on gate valve to accommodate tapping machine.

5. A shell cutter and adapter of the proper size are securely fastened in the socket of the boring bar by engaging threads on the plug retainer with threads in the shank of the adapter. The shell cutter is then lubricated with grease for the drilling operation.

6. The tapping machine is then installed on the gate valve, and the valve is fully opened.

7. The clutch on tapping machine gear case is disengaged. A small hand

*The information contained in this article was submitted to The James F. Lincoln Arc Welding Foundation, Cleveland, Ohio, in its $200,000 Design-for-Progress Award Program for reports on advancements and improvements made by the application of arc welding in design, fabrication, construction, and maintenance. It was one of the winning papers. The author has made a number of changes in the original manuscript and adapted it for publication in The Petroleum Engineer.

†Superintendent of Line Maintenance, Stanolind Pipe Line Company.

Tapping machine in use on Oklahoma line.

crank is placed on the countershaft and rotated to the right for inserting boring bar through the gate valve.

8. When the shell cutter on the boring bar makes contact with the pipe, the clutch is engaged, and small hand crank is removed.

9. The large hand crank is placed on the worm shaft and drilling operation follows. The gear head feeds the shell cutter into the pipe automatically throughout the drilling operation.

10. After drilling is completed, the clutch on the tapping machine is disengaged and the boring bar is withdrawn by rotating countershaft to the left with small crank. The gate valve is then closed and the tapping machine may be removed from the valve.

1. The tapping machine may be operated either by hand crank or with an air motor during the drilling operation.

Procedure for removing plug from tapping nipple previously welded onto pipe line follows:

1. The bull plug or blind flange is removed from the tapping nipple.

2. The special plug is loosened with a wrench or other suitable tool by unscrewing one or two threads.

3. The gate valve is installed on the tapping nipple.

4. Tapping machine is installed on gate valve.

5. Gate valve is fully opened and clutch on tapping machine gear case is disengaged. Hand crank on countershaft is rotated to the right to insert boring bar through gate valve.

6. After socket on boring bar makes contact with shank of special plug, boring bar is rotated slowly to right about one-fourth revolution and, at the same time, slight inward pressure is held on boring bar with small hand crank and after socket of boring bar slips over shank of plug small hand crank is rotated until boring bar socket is fully engaged with shank on plug. The plug retainer shaft is then engaged with threads in shank of plug.

7. Boring bar is rotated slowly to left, and hand crank on countershaft is rotated to left simultaneously. The rotation of the countershaft must be slightly faster than the rotation of the boring bar to compensate for the difference in thread lead (threads on the plug disengage faster than the boring bar would travel outward in normal operation).

8. After plug is disengaged from threads in tapping nipple, countershaft hand crank is rotated to left to withdraw boring bar from gate valve.

9. Gate valve is then closed and tapping machine may be removed from gate valve.

10. Tapping machine must be operated by hand crank when removing plug.

Procedure for installing plug in tapping nipple through gate valve follows:

1. Special plug is installed in socket of boring bar and plug retainer is firmly engaged with threads in shank of plug.

2. Tapping machine is installed on gate valve.

3. Gate valve is fully opened, and countershaft is rotated to the right with hand crank to insert boring bar through gate valve.

4. After plug comes in contact with internal threads in tapping nipple, boring bar is rotated slowly to right; countershaft hand crank is rotated simultaneously to hold slight pressure against plug. When thread on plug engages with thread in tapping nipple, boring bar and countershaft are rotated simultaneously until plug is tightened firmly. Plug retainer shaft is then disengaged from plug and countershaft is rotated to left with hand crank to withdraw boring bar from shank of plug and gate valve.

5. Tapping machine is then removed from valve.

6. Gate valve is removed from tapping nipple.

7. The special plug is then securely tightened in tapping nipple with wrench or other suitable tool.

8. A pipe coupling and bull plug may be installed on tapping nipples having external threads, and suitable blind flange with bolts and gaskets is used to close the flanged type tapping nipple.

9. Tapping machines must be operated by hand when inserting a plug.

Fig. 1 shows a typical installation of a portable pumping unit as employed to empty a section of line by transferring the oil into another pipe line that lies parallel. The pumping unit is usually set at a location having a lower elevation than the section of pipe line to be drained, which assists the flow of the oil by gravitation toward the pumping unit. Preparatory to connecting the pumping unit a tapping nipple, either 3-in., 4-in., or 6-in. (depending upon the size and capacity of the pumping unit), is arc welded to the pipe line to be emptied. A similar tapping nipple is arc welded to the parallel pipe line. A standard gate valve is installed on the tapping nipple and a tapping machine is then attached to the gate valve for drilling the openings into pipe lines described heretofore. The drilling operation required from 10 to 20 minutes, depending upon the size of the tapping nipple and wall thickness of the pipe line. With the improved machine the drilling operation may be performed while the pipe line is operating at pressures up to 800 psi without the loss of fluid or pressure. After open-

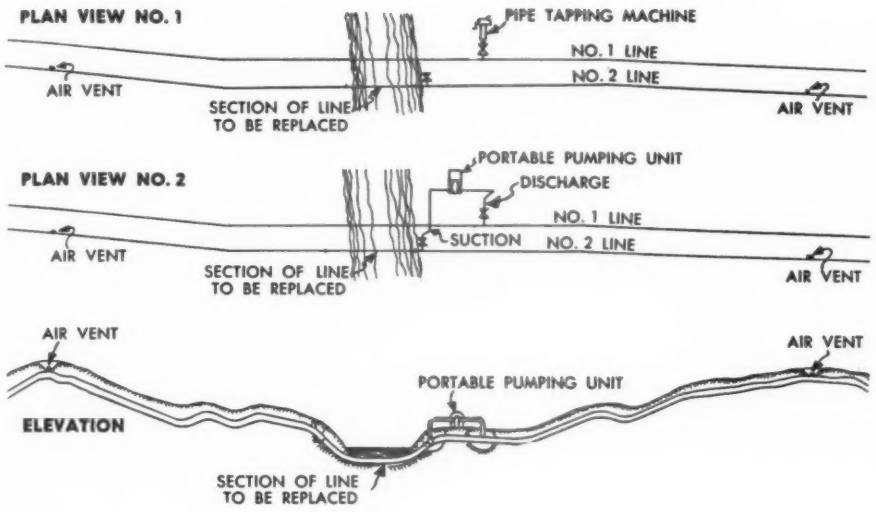

FIG. 1

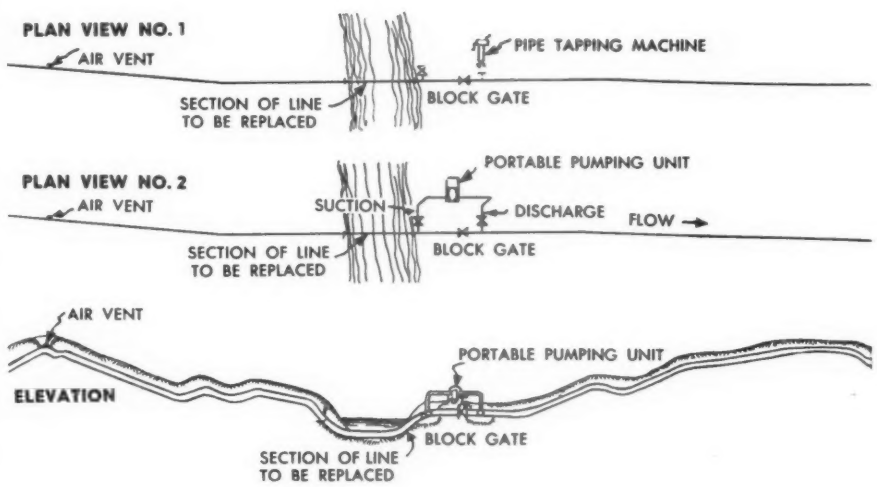

FIG. 2

ings have been made in both tapping nipples a suction line to the pumping unit is connected with the line to be emptied and a discharge line from the unit is connected to the parallel pipe line.

In evacuating pipe lines with portable pumping units, or by other means, it is essential that air be admitted to the pipe line as the fluid is removed, otherwise the draining operation will not be complete. Also, it is very important that the evacuation be thorough, (before cutting the pipe line and making preparations for tie-in welds), and any oil not transferred by the pump must be disposed of to prevent explosions and subsequent fires while welding is in progress. Due to the difference in ground elevations traversed by pipe lines, the draining operation can be greatly facilitated and more complete by tapping the pipe line to admit air at one or two high points, as oil may be held in suspension by vacuum at the crest of hills. The small Model 200 tapping machine provides a convenient and economical means of tapping a line at the high points.

After the pumping unit has been connected in the manner described above, and the air vents have been installed, the pipe line is taken out of service and evacuated with a pumping unit. After the line has been drained and work completed, the openings drilled in pipe line through the tapping nipples are plugged with a special plug by use of the tapping machine as described above. This permits removal of the gate valves used in conjunction with the pumping unit.

Fig. 2 shows typical installation of a portable pumping unit connected with tapping nipples when used to drain a section of pipe line where no parallel line exists into which the fluid may be transferred. In this instance, the oil evacuated from the section of line to be repaired and relocated, is pumped into the other section of line around the block valve, which is closed preparatory to transferring the oil and making repairs to the pipe line. Within the last decade it has become the general practice by some pipe line companies to install block valves in pipe lines at strategic locations during the construction period for controlling drainage should leaks or breaks occur. The block valves provide a convenient means of draining the line for repairs or changes in construction. By use of the tapping nipple and tapping machine it is possible to make openings for connecting a pumping unit or other facilities at any location on a pipe line system, furthermore, tapping nipples are frequently installed on main trunk pipe lines and artery lines, for connecting field gathering lines, because this type of connection can be made at a nominal cost, and eliminates the delay and expense of draining the artery line. The tapping nipples and tapping machines are used advantageously for connecting certain facilities at the pipe line pump stations.

In addition to being used on pipe lines, tapping nipples are installed on crude oil storage tanks to provide openings to which gate valves and piping may be connected to agitate and flush out heavy accumulations of BS&W. For this operation four tapping nipples are installed at 90-deg intervals around the circumference of the tank a few inches above the tank bottom, however, safe procedures must be followed in welding tapping nipples on a tank that contains oil or petroleum vapors, and, because of the hazards, it is advisable to install the tapping nipples while the tank is being erected, or is cleaned for making repairs.

Development of the Model 1200 tapping machine and the large tapping nipples greatly extends the usefulness of this equipment in making connections at pipe line pump stations, intermediate junctions, and tank farms; and a substantial saving in time and labor cost can be effected, because various types of connections may be installed without draining the lines or shutting down pumps.

The design of this machine insures a maximum of safety to the operators in tapping pipe lines under high pressure, and by the generous use of ball and roller bearings in the journals, the machine may be operated with a minimum of physical effort on the part of the workmen. ★ ★ ★

Tanker Transportation*

By M. G. GAMBLE†

IN a panel of this kind where the subject of National Defense is in the foreground, it is natural that the trend of thought should lead to the source of energy most commonly used in fueling a war machine, namely oil, and the means of transporting it to the place where it will be used. This brings us to the subject of tankers, without which the waging of modern war would be utterly impossible. Like most of the other great tools of industry and of national defense, the present day tanker resulted from a long period of evolution.

Following the discovery of oil in Pennsylvania in 1859 the problem of petroleum transportation by water presented itself. An economical means of transporting the oil from the upper reaches of the Allegheny River to the Pittsburgh area was initially found through the use of rafts steered by poles and floated down the river with the current. This means of transport was followed by improvement in barge design and by ocean shipments by means of cases and barrels loaded in dry cargo sailing vessels. Later, an early type of tanker was developed. It contained separate steel tanks with air spaces under and around them. The chief objection to this latter type of carrier was a tendency of excess gas to collect in the space around the tanks with consequent danger to personnel and equipment.

However, in 1886 the transportation of oil by tanker in much the same manner as we know it today began with the construction in a British shipyard of the *SS Gluckauf*. Since that time considerable progress has been made in hull and machinery design and much more is in prospect; but the principle of carrying oil in tanks extending to the skin of the ship in a large seagoing vessel has remained the same over these 62 years, and there is little likelihood of this form of transportation meeting any serious competition in the future.

The trend of tanker design has always been toward larger and faster ships, but the greatest progress in this direction has been within the last ten years. In 1938 in order to facilitate the construction of tankers satisfactory to the Navy Department for use as Navy oilers, and at the same time serviceable in commercial trades, Standard Oil Company (N. J.) entered into a contract with the U. S. Maritime Commission that resulted in our company placing contracts with four shipyards for the construction of a total of 12 such tankers. The vessels had a deadweight of about 18,300 tons, a contract speed of 18 knots, and a capacity of about 146,000 bbl.

Under the terms of this agreement and in collaboration with the Navy and the Maritime Commission, the Standard Oil Company (N. J.) designed and built these special tankers and the government paid the cost of the National Defense features. At that time these ships were among the largest and were the fastest tankers ever built in American shipyards. The National Defense features incorporated in them enhanced their value for speedy and economical conversion into Naval auxiliaries—and four of them were even converted into baby flat tops. These vessels also paved the way for the government's extensive war-time tanker construction program and for the larger tankers being built by private industry today.

In a general discussion of tankers it is interesting to review and compare the tanker tonnage situation during and after the two world wars. In 1914 the total world tanker fleet consisted of little more than 2,000,000 deadweight tons; about 87 per cent of which was under foreign flags. However, due largely to construction in U. S. shipyards the world tonnage by the end of 1921 had increased to about 7,000,000 tons, more than half of which was under the U. S. flag. But unlike the situation at the close of the recent war, U. S. Government owned tankers accounted for only about one-fourth of the U. S. flag tonnage. A business depression then set in, which, coupled with low cost construction in European yards, brought building in U. S. yards to a standstill. In the period from 1921 to 1929 foreign flag tonnage increased about 150 per cent due to construction in Europe, while in the United States we were struggling to absorb the American flag surplus.

In 1929-1930 it began for a time to look as though U. S. tanker construction would again come into its own, but once again a serious business depression called a halt. By 1935 the U. S. flag tanker fleet had dropped to about 30 per cent of the world tonnage and consisted mainly of vessels approaching obsolescence. Although there was a gradual rise in the construction of tankers from that year, the pace of building in U. S. yards did not approach that in foreign yards until 1941. In 1942 submarine warfare reached its peak; U. S. ship construction was speeded up rapidly, and for the first time since World War I tanker construction in this country exceeded that in foreign yards. The bulk of our war-built commercial fleet, which consisted of about 9,000,000 tons of T-2 type tankers having a deadweight of about 16,600 tons and a speed of 15 knots, was constructed during the next three years. Today, about 43 per cent of the world's tanker tonnage is under the U. S. flag, and while the volume of tonnage under construction here does not equal that being built in Europe, I am glad to say that orders recently placed here call for a substantial number of tankers having a deadweight of 26,000 or more tons and a speed of about 16 knots.

Although the war resulted in the loss of about 40 per cent of the prewar world-wide tanker fleet, this was more than replaced by new construction, and the overall effect has been to hasten the general utilization of larger and faster ships. One might say that size and speed more than any other factor, are means of combating today's high transportation costs, which have more than doubled since 1939.

On the other hand, it should be remembered that the larger and faster the vessel the more valuable her time and the greater the possible savings from improved turnaround. In fact, we might go so far as to say that from the standpoint of economy, quick turnaround is second only in importance to the utilization of large, fast ships. Even a T-2 has an average cost at the dock of about $2000 per day, and the corresponding cost of a modern 26,000 ton vessel would be about 30 per cent more. This gives some idea of the importance of keeping port time to a minimum.

The industry's tanker tonnage position today is very different from what it was a year ago. At that time we were in the throes of transition of the war-built fleet from government to private ownership and many tankers were immobilized until the com-

*Presented before Panel on Merchant Marine and National Defense, October 13, 1948.

†General manager of Marine Operations, Standard Oil Company (New Jersey).

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pletion of this transition several months ago. In other words, from the fall of 1947 and extending through the spring of 1948 we were all feeling the effects of an apparent serious world-wide shortage of tankers, while the fact was that the tankers afloat during that period would have been ample had they all been in operation. During recent months, our problem has been to find use for the surplus tanker tonnage, as private companies have been forced, because of the lack of business, to tie up from 60 to 70 tankers. Under these conditions it is unlikely that a serious shortage of tanker transportation will develop during the coming winter period.

Here, it might be interesting to summarize the tanker tonnage in the world today and express it in terms of the T-2 type, which we might call the representative war-built tanker.

A survey made last April of tankers of 2000 gross tons and over showed that including all types there were the equivalent of 1264 T-2s in the world with an aggregate deadweight of about 21,000,000 tons. Of these, 542 vessels or 9,000,000 tons were under the American flag. Other Western Hemisphere tonnage totaled 149 ships of this type, having a deadweight of 2,500,000 tons, and Eastern Hemisphere tonnage accounted for the remainder of 573 vessels or 9,500,000 tons.

Summarizing the world's tanker fleet from another point of view, it is interesting to note that tonnage under the U. S., Panamanian, and Canadian flags represents about 53 per cent of the total, and if we add the tonnage owned by ECA countries we find that 95 per cent of all the tanker tonnage in the world is thus accounted for.

It is difficult to forecast the adequacy of the world's tanker fleet to take care of future petroleum transportation needs. This is particularly true today when there are substantial movements from the Persian Gulf to this hemisphere, which involve four times the tanker tonnage required for a movement of the same volume from the U. S. Gulf to New York. It is my feeling, however, that under peacetime conditions the tankers now available, augmented by new deliveries that might reasonably be expected, will be very closely in balance with expected transportation needs for the next few years. Much, of course, will depend on the extent to which obsolete vessels are retired from service, which in turn is largely influenced by the tanker market and resultant freight rates.

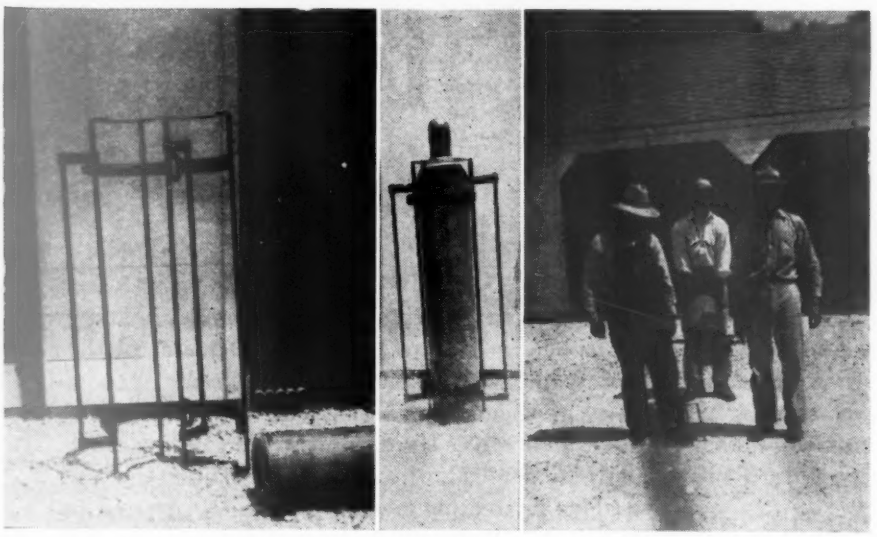
If we assume that over a long-range period of say 20 years the average life of a tanker is 20 years, additional new tonnage to the extent of 5 per cent of the existing fleet would be required annually, without any regard for increased oil requirements or any effect from possible longer hauls. If, in addition, we assume a long-term factor of say 3 per cent annually, representing overall increased petroleum transportation requirements, 8 per cent of the total tonnage or about 100 equivalent T-2s in the form of new construction would be required each year. At this point the question might well be raised as to how well the tanker construction program now under way would meet such a requirement over the next few years.

In 1947, 31 ocean tankers were constructed throughout the world, all but one of which were delivered from foreign yards. So far this year, only 21 tankers have been delivered, but 28 others reported launched in European yards will undoubtedly be delivered before the year end. Adding probable completions in this country of 4 or 5 more we get a total of more than 50 new tankers for addition to the world fleet in the current year. According to the best available information there are the equivalent of 115 T-2s under construction or on order in the United States today, and 286 of the same type building or on order in Europe—thus making a total of more than 400 equivalent T-2s scheduled for delivery over the next four years. This represents an average of 100 per year, which strangely enough coincides with the long-range requirement of about 100 per year previously mentioned. On the other hand, if, as appears likely, the average long-term rate of growth in requirements will be exceeded over the near term, a balance might well be arrived at by further postponement of retirements for obsolescence.

In viewing the world-wide tanker situation, I cannot help but feel that the most difficult period of postwar readjustment is behind us, and that the industry can be depended upon to meet all anticipated commercial requirements under peacetime conditions. Speaking for our own company, as one member of the industry, I should like to assure our friends in the Navy and the Maritime Commission of our fullest cooperation and assistance at all times in any matters affecting the National Defense. ★★

OXYGEN CARRIER DEVICE

By O. C. IRVINE



Members of a United Gas Pipe Line Company crew in the New Orleans area have been credited with the development of a novel carriage device for handling oxygen bottles.

The carrier, built entirely from scrap materials, is designed to facilitate handling of the heavy containers during pipeline operations in the swampy sections of the company's New Orleans district. Members of the company's section crew at Kenner, Louisiana, developed and built the carrier.

The idea was first suggested by Vincent Abate, station attendant, following a Kenner section crew safety meeting at which crew members discussed the hazards of handling the bulky and weighty oxygen bottles over the swampy terrain within their operating territory.

With Abate's initial suggestions, the crew members set to work and built their carrier, an extremely simple gadget in design. It is made from four bars of reinforcing rods hinged together with a collar to fit both ends of the cylinder. Two hinged handles are attached to provide hand-holds for carrying the case and the enclosed oxygen bottle.

Designed so that it can be carried handily by either three or four men, the carrier has minimized a potential hazard on jobs in the marshlands characteristic of the region.

WITH THE Pipe Line Contractors

J. R. Horrigan Construction Company, Inc., Houston, Texas, reports progress of its pipe line construction jobs as follows: On the 470 miles for Michigan-Wisconsin Pipe Line Company, Gang No. 3 has completed the 104-mile section, which carries the line 4 miles past Maryville, Missouri. Gang No. 2 will resume operations about November 15 out of Manhattan, Kansas, on arrival of sufficient pipe to complete this section, which was originally 80 miles with 34 miles still to lay when work starts again. This section should be completed this year. Gang No. 1, which consists of 270 miles of this line, will complete operations by December 5, and is now working out of McPherson, Kansas.

The job for the Texas Gas Transmission Corporation, near Memphis, Tennessee, 32 miles of 26-in., is 70 per cent complete (November 4) and will be finished in approximately three weeks.

All operations on the 11 miles of 24-in. at Clay Center, Kansas, for Northern Natural Gas Company are finished. This line was put in operation October 26.

Midwestern Constructors, Inc., Tulsa, Oklahoma, announces the status of projects in which it is engaged (November 1) as follows:

Shell Pipe Line Corporation—Relocation of lines, Chain and Rocks Canal, Wood River, Illinois. This work began August 1 and was completed October 25. Earl S. Powell was the superintendent in charge.

A contract also has been awarded by Shell for laying of 79 miles of 22-in. from Cushing to Chelsea, Oklahoma. Work began on the right-of-way November 15 and laying will begin December 1. M. T. Wilhite is superintendent.

Socony-Vacuum Oil Company, Inc.—155 miles of 8-in. from Malvern, Pennsylvania, to Binghamton, New York. Work began June 1 and the line is expected to be completed by December 1. There are two field offices, one at Wilkes-Barre, Pennsylvania, where Lacy Walker is superintendent, and the other at Montrose, Pennsylvania, where Richard Leonard is superintendent. A 6-in. branch line is being laid from Socony-Vacuum's 8-in. main line to the Allentown, Pennsylvania, bulk terminal. Work began November 1 and the job is scheduled for completion December 1. The field office is at Allentown with Lyle S. DeWitt as superintendent.

Ohio Fuel Gas Company—Lay 40 miles of 20-in. line near Sugar Grove, Ohio. This line is expected to be completed by December 1. Clyde Peters is the superintendent and the field office is at Wellston, Ohio. Also in the vicinity of Sugar Grove 90 miles of pipe is being taken up under the superintendency of J. L. Crosier.

Panhandle Eastern Pipe Line Company — The 15-mile, 26-in. loop at Centralia, Missouri, was completed October 30. The 17.1-mile, 26-in. loop at Glenarm, Illinois, was completed October 25. Work began November 1 on a 10.8-mile, 26-in. loop at Pleasant Hill, Illinois, which is expected to be finished by December 1. The present field office is at Pleasant Hill. M. T. Wilhite is the superintendent.

General Electric Company—Bottle storage installations were completed November 1, 34 bottles at Circleville, Ohio, 24 bottles at Bucyrus, Ohio, and 24 bottles at Bellevue, Ohio.

Ray L. Smith and Son, Inc., Eldorado, Kansas, is scheduled to have completed by December 1 the 26-in. line it is laying for Cities Service Gas Company from Ulysses to Hutchinson, Kansas. A 13-mile, 16-in. loop also is being laid around the north and east side of Wichita, which will connect with the above line. William G. Frost is in charge of construction of the 26-in. line, and M. O. Newby of the 16-in. loop.

Work is progressing on the 45-mile takeup of a 16-in. line at Oswego, Kansas. This also is for Cities Service Gas Company.

Vaughn & Taylor Construction Company, Inc., Wichita Falls, Texas, had completed on October 26 about 30 per cent of the 90-mile gathering system being constructed for Phillips Petroleum Company near Guymon, Oklahoma (Sherman field lines). Laying is at the rate of approximately 5000 ft a day. This project includes 40 miles of 24-in. pipe. D. D. Vaughn is supervising the job.

N. A. Saigh Company, San Antonio, Texas, early this month completed three river lines across the Mississippi at Greenville, Mississippi, for Texas Gas Transmission Corporation. Two of the lines were 12-in. and one 14-in. On each side of the river 26-in. land lines were laid to existing headers. The middle of the month 33 miles of 26-in. from Lula to Banks, Mississippi, was completed for the same company.

Contract was recently granted the Saigh company by East Tennessee Natural Gas Company for the construction of 186 miles of 16-in. from Centerville to Chattanooga, 112 miles of 12-in. from Chattanooga to Knoxville, and 100 miles of miscellaneous lateral lines ranging from 4 in. to 8 in. in diam.

Sheehan Pipe Line Construction Company, Tulsa, Oklahoma, is nearing completion on its two major construction jobs. These consist of 40 miles of 24-in. gas line loops for Southern Natural Gas Company in Mississippi and Alabama, and 110 miles of 12-in. crude oil line for Buckeye Pipe Line Company in Ohio. The latter extends from Cygnet to Cleveland. Construction offices are at Grafton.

Latex Construction Company, Houston, Texas, announces that approximately 30 miles had been laid (October 22) of the 60 miles of 16-in. crude oil line being constructed for The Texas Pipe Line Company from East Houston to West Columbia, Texas. F. A. Silar is superintendent and C. V. Oliver is in charge of the office, which is in Angleton at the present time.

The 70 miles of 24-in. loops being laid for Southern Natural Gas Company in eastern Alabama and Georgia is progressing nicely and about 55 miles had been completed on the date mentioned. The superintendent in charge of this job is W. H. Hayes. M. L. Thompson is assistant superintendent, and A. E. Stremmel and John Strickler are in the office. Present headquarters are at Anniston, Alabama.

On the job that embraces the taking up of 140 miles of 6, 8, and 10-in. pipe between Humble and Port Arthur, Texas, and yard reconditioning it for The Texas Pipe Line Company, about 50 miles had been completed. H. L. Leake is in charge of take-up, Sam Harrison, office;

H. E. Murphy, in charge of rack, and E. L. Peterson, office. Present headquarters are at Liberty.

Construction of tank farm piping, pump station and manifolds for The Texas Pipe Line Company at West Columbia, Texas, was about half completed. J. B. Latham is superintendent and W. E. Bayles is in charge of the office.

Approximately 10 miles of the 18 miles of 16-in. loop line being laid near Baton Rouge, Louisiana, for Interstate Oil Pipe Line Company was completed. J. A. Cantrell is superintendent and John Stoddard is in charge of the office. Headquarters are at Baton Rouge.

On the 40-mile 10-in. gas line being constructed for Lone Star Gas Company from Sulphur Springs to Paris, Texas, approximately 12 miles had been laid. The superintendent is E. C. Norris. Ralph Axsom is in charge of the field office at Sulphur Springs.

A contract has just been awarded Latex by Houston Pipe Line Company to take up, recondition, and re-lay 65 miles of 12-in. pipe. The pipe will be taken up in the vicinity of Alice, Texas, and re-laid from a point east of Houston to Village Mills, Texas. W. A. Briley is in charge of take-up; J. J. Nolan, office. Other personnel not yet selected. Headquarters will be at Alice.

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▸ **Williams Brothers Corporation,** Tulsa, Oklahoma, is just starting (November 5) 47 miles of 10-in. line for The Texas Empire Pipe Line Company between Cushing and Tulsa, Oklahoma. The field office is at Drumright, with T. E. Davis superintendent and John Purdy office manager. In addition, some town work is being completed for The East Ohio Gas Company in Cincinnati, for the Louisville Gas and Electric Company in Louisville, and for the Atlanta Gas and Light Company in Atlanta.

The project in Old Mexico is going along according to schedule and the contractor expects to move its crew into Mexico City during the latter part of November and complete the last 28 miles of the line from that point. This is a 150-mile, 20-in. natural gas line being laid from Poza Rica to Mexico City for Petroleos Mexicanos.

The company is constructing 155 miles of 24-26-in. crude oil line for Creole Petroleum Corporation from Ule tank farm to La Salina-Amuay Bay, Paraguana, Venezuela. Another line is the 255-mile 6-in. oil line for Yacimientos Petroliferos Fiscales Bolivianos from Camiri to Cochabamba to Sucre. The work in Venezuela and Bolivia should be completed the latter part of February.

▸ **H. C. Price Company, Somastic Division,** Bartlesville, Oklahoma, announces activities as of November 1:

Buckeye Pipe Line Company—Contract made early in 1948 for the application of Somastic coating to approximately 82 miles of 22-in. O.D. pipe, which will be laid from Lima to Toledo, Ohio. Plant is at Lima, Ohio. Phone 74151. Elwood Roth, superintendent; J. C. Caldwell, office manager.

Buckeye Pipe Line Company and Standard Oil Company—Contract received late in 1947 for application of Somastic coating to approximately 120 miles of 12¾-in. OD pipe and 9 miles of 8⅝-in. OD pipe, which is being laid from Cygnet to Cleveland, Ohio. W. G. Glenn is project superintendent. The address is 7400 Brookpark Road, Cleveland, Ohio. Phone: Ontario 9015.

Socony-Vacuum Oil Company, Inc. —Order received during March covering application of coating to 125 miles of 6⅝-in. OD pipe for a products line to be laid from Portland to Bangor, via Augusta, all in Maine. Elwood Roth is project superintendent; J. G. Umbarger, office manager. The address is P. O. Box 32, New Gloucester, Maine. Phone 49-R-2.

Order received during March covering application of coating to approximately 154 miles of 8⅝-in. OD pipe for a products line to be laid from Malvern, Pennsylvania, to Binghamton, New York. Hugh Clements is project superintendent; M. Anderson, office manager. The field office is at Taylor, Pennsylvania. Phone Scranton 42277.

Order received during April covering application of coating to approximately 35 miles of 6⅝-in. OD pipe, which will connect with the Pennsylvania to New York line and feed various distribution points along the line. This office also is at Taylor with the same officials in charge as above.

Philadelphia plant operations are announced as follows:

Consolidated Edison Company—Purchase order received March 11, 1948, covering Somastic coating and interior cleaning and coating of approximately 7000 ft of 8⅝-in OD pipe.

Purchase order covering coating and interior coating of 96,500 ft and interior and exterior coating of 10,500 ft of 8⅝-in. pipe received early in 1948.

Phelps Dodge Corporation—Order received March 16, 1948, covering coating of 42,500 ft of 5½-in. OD pipe and 3520 ft of 6-in. OD pipe

Sinclair Refining Company—Contract received in June for the application of coating to approximately 28 miles of 8⅝-in. OD pipe, which will be used for transportation of petroleum products from Sinclair's Chelsea pump station to its Philadelphia terminal. Key personnel at the Philidelphia plant include E. Rowland English, manager; M. J. Lane, superintendent; J. E. Sponeybarger, foreman; T. L. Huitt, office manager. Address: P. O. Box 6120, Bustleton, Philadelphia 15, Pennsylvania. Phone Somerton 6-8132.

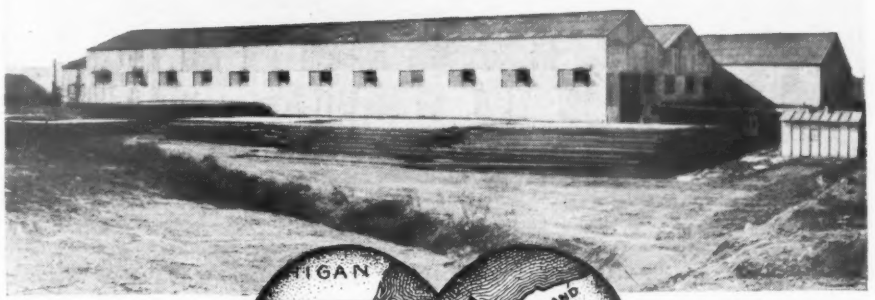
▸ **Eastern Construction Company,** Dallas, Texas, had completed about 15 per cent (November 3) of the Lone Star Gas Company's 70-mile, 20-in. line between Opelika and Dallas, Texas. Considerable difficulty has been experienced in obtaining pipe. F. K. Brown is the superintendent in charge.

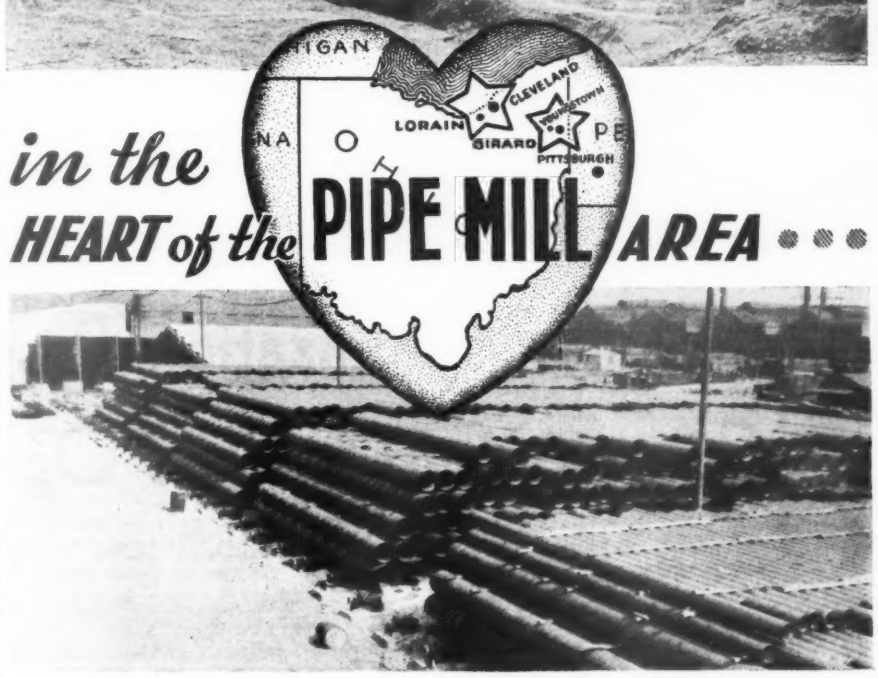
▸ **R. H. Fulton and Company,** Lubbock, Texas, has contracted to lay 114 miles of 26-in. pipe in western Kansas for the Panhandle Eastern Pipe Line Company. Near Douglas, Wyoming, the company has a take-up and reconditioning job for Stanolind Pipe Line Company, which consists of 51 miles of 8-in. and 12-in. pipe. Also near Douglas 23 miles of 12-in. and 39 miles of 16-in. are being laid for Stanolind.

▸ **Trojan Construction Company,** Oklahoma City, Oklahoma, had completed (October 24) approximately 85 per cent of the 71-mile 16-in. line being constructed for Oklahoma Natural Gas Company between Maysville and Holdenville, Oklahoma. Thirty-one miles of 12-in. from Maysville to Velma was about 20 per cent completed. The 14,000 ft of 10-in. near Lindsay, Oklahoma, for the same company was about 90 per cent completed. Beginning about December 1, Trojan will lay for Oklahoma Natural 8 miles of 18-in. and 1½ miles of 16-in. from Muskogee County to Okmulgee County.

▸ **R. B. Potashnick,** general contractor, Cape Girardeau, Missouri, has completed two of the three loops he has been laying for Stanolind Pipe Line Company. The ones near Lawrence, Kansas, and Hastings, Nebraska, have been completed. The one near Kearney, Nebraska, is about 75 per cent completed (November 2). The length of these loops totaled 65 miles. Of the two loops being laid for Panhandle Eastern Pipe Line Company, the one near Houstonia, Missouri, has been completed. The loop near Harrisonville, Missouri, has just started. These loops total 44 miles and are of 26-in. pipe.

HILL, HUBBELL PLANT LOCATIONS





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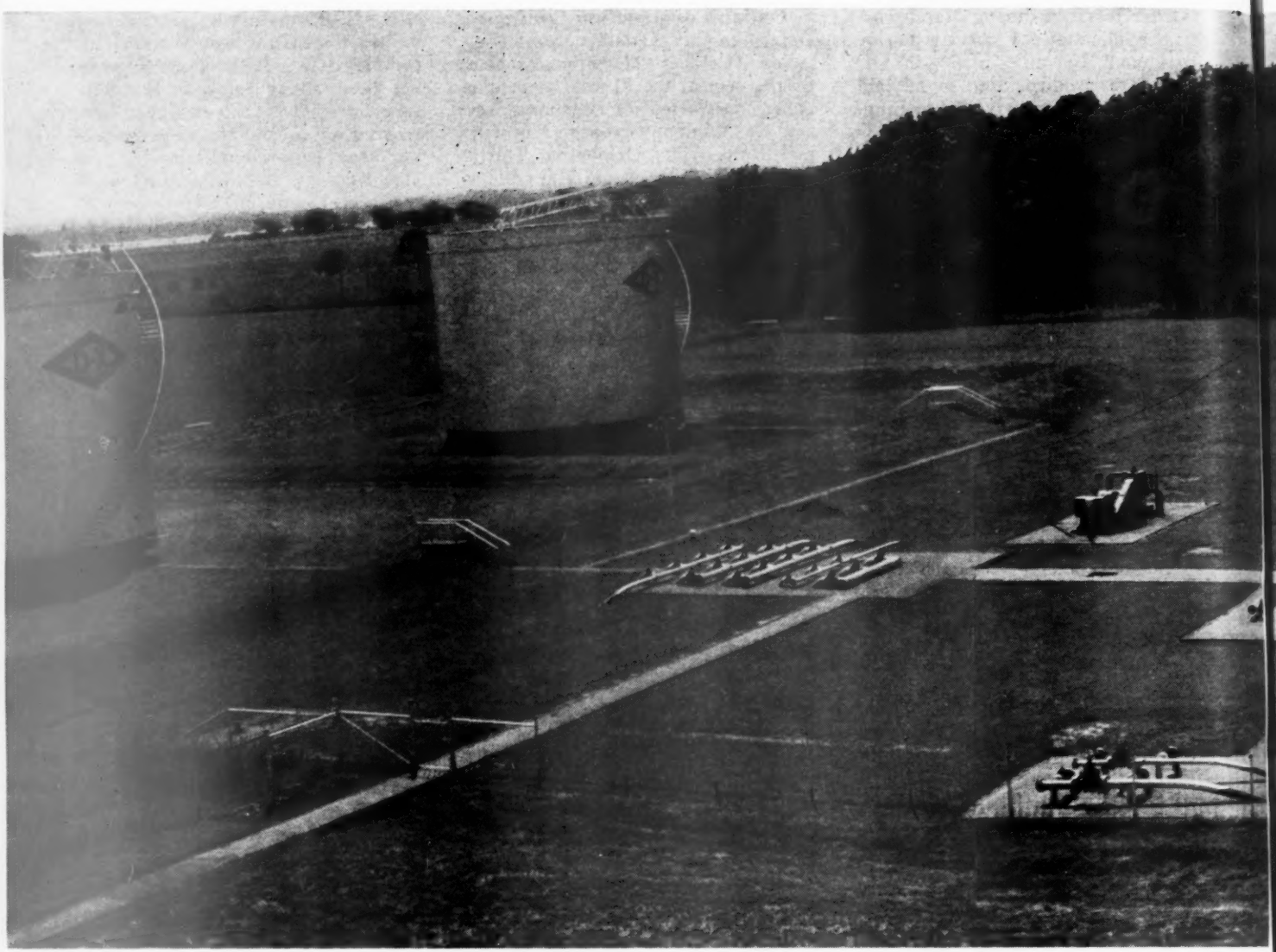


Station Modernization Program Increases Capacity and Lowers Operating Costs

By FRANK H. LOVE*

DURING the last several years the Mid-Continent Pipe Line Company of Tulsa, Oklahoma, has had underway a station modernization program designed to improve mechanical efficiency, lower operating costs, and increase line capacity. Although the entire program has not been completed, the major part has, which together with the installation of a number of booster stations has resulted in an increased crude oil capacity of 50 per cent.

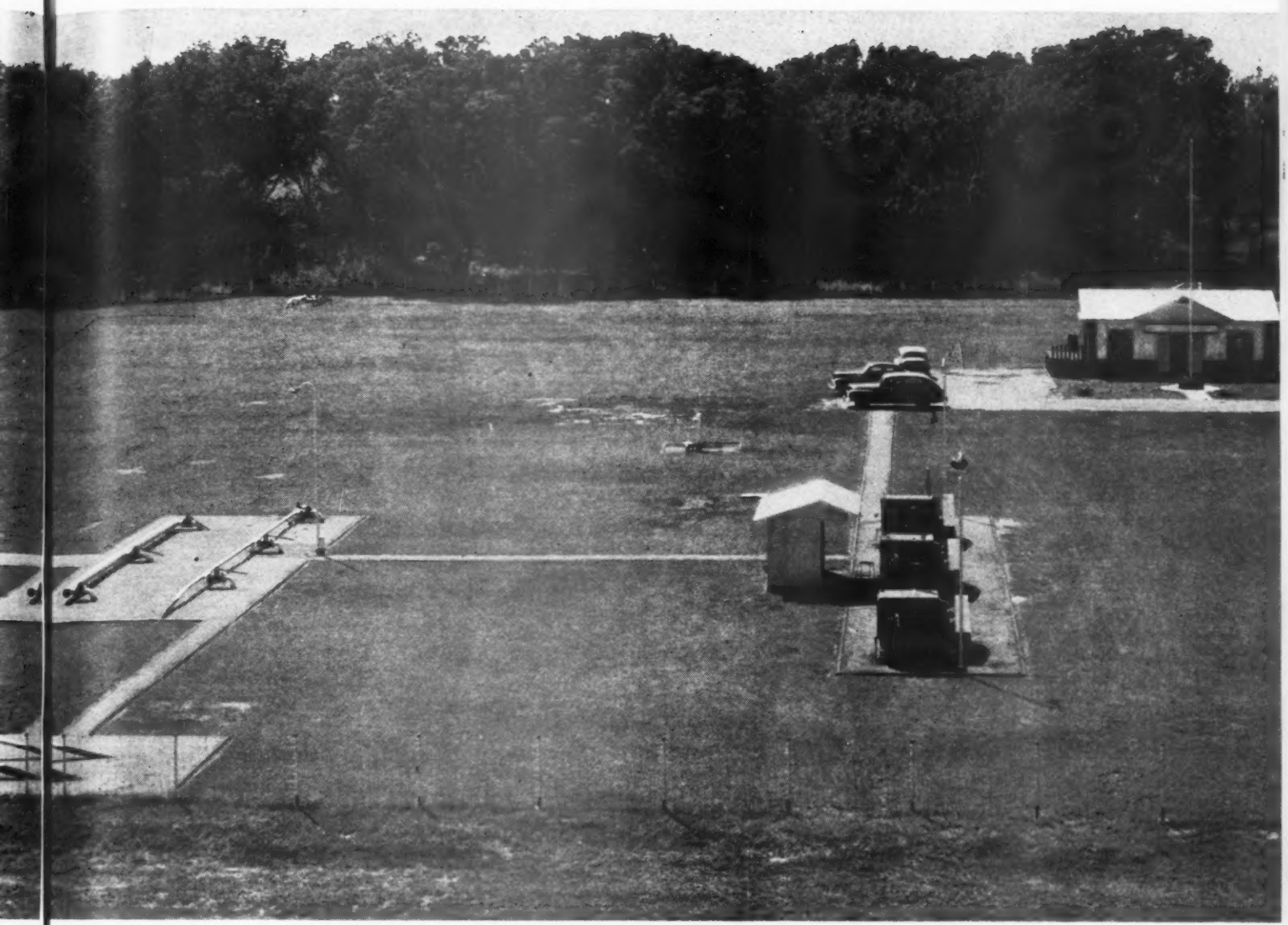
Operations of the Mid-Continent Pipe Line Company are somewhat unusual in that they are centered wholly within the boundaries of the State of Oklahoma. The company's system consists of 1436 miles of lines ranging in diameter from 2 in. to 10 in., and 17 major stations, in addition to which there are several small field stations. The system, which covers almost the entire eastern half of the state, receives oil from 3600 wells on 1018 leases, or about 8 per cent of the producing leases in the state.

This is one of Oklahoma's earliest pipe line systems, having begun operations in 1914 as the Cosden Pipe Line Company. The name was changed to Mid-Continent Pipe Line Company in 1941. As a result of the modernization program most of the older equipment has been replaced and what little remains is earmarked for exit.

The system, as it now exists, is an interesting one in which varied types of pumping stations are included. Some of the pumping units are housed, other equipment is of a type that requires no housing, hence these units are left in the open. Some of the

*Pipe Line and Marine Transportation Editor.

EXCLUSIVE



Mid-Continent Pipe Line Company's Harris station in the West Moore field, Oklahoma. Main pumping units are in right foreground, office building in background. In center are manifold, suction pump, and scraper trap. At left are working tanks.

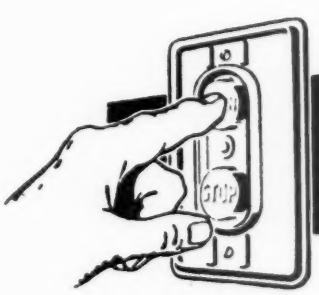
stations are fully automatic and require little attention. In some instances the stations are started in the morning by a field gauger and are shut down by an electric clock after they have pumped their allotted volume. One type of station, of which there are five, is operated by telephone remotely from another station, being controlled by means of a microphone and shutdown relay. The microphone makes it possible for the operator at the control point to hear the running engine at the remote station and thus be apprised of any faulty operation. Should an emergency arise, he can shut down all station equipment. A detailed description of the new construction work follows:

Pumping units at Harris station consist of two 90-hp and one 100-hp gas engines driving reciprocating pumps. Control panel is shown in small open-faced house.

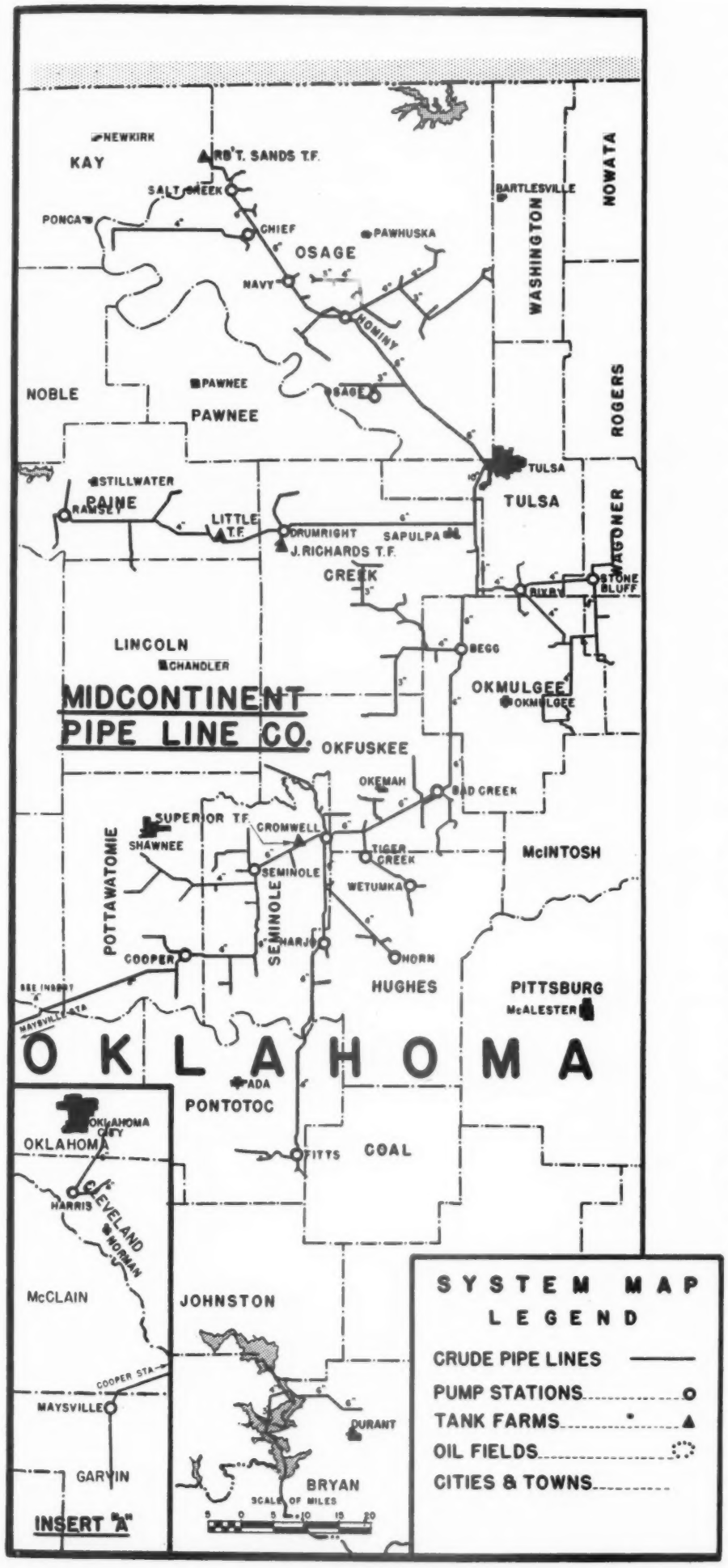
▸ **Bad Creek Station.** At Bad Creek station near Henryetta, so thoroughly has been the revamping process that this is in effect a new station. Maximum capacity is 28,000 bbl per day at an operating pressure of 825 psi. Pumping equipment consists of three units, two 375-hp, and one 200-hp gas engines driving reciprocating pumps. The smaller unit is used to increase capacity when the booster station at Beggs is in operation. The rated horsepower of the engines is seldom utilized, under ordinary operation only 200 to 225 hp of the 375 hp engines are brought into play and only 100 hp of the 200-hp engine.

Experience gained in construction and operation of new pipe line systems proves and justifies the trend to larger diameter lines, fewer pump stations, and simplified pumping equipment. Low-cost electric power enables you to attain the fullest economy in application of these three factors. Motor-driven pumps require less initial investment . . less maintenance expense . . and less for operation and labor. A minimum of attention and supervision is necessary when you have "pushbutton control" of your pumping equipment.

Purchased electric power insures lower pumping costs.



HOUSTON LIGHTING & POWER COMPANY



Engines and pumps are connected through a firewall by means of V-belts and two flexible couplings for each unit. The only openings in the firewall are windows of fire proof glass through which the gauges and pumps can be observed.

Latest type automatic regulators are used on the jacket water cooling system to control flow and maintain a constant temperature. Engine starting is by means of a 7-hp, 5-cylinder radial air motor connected to the Bendix of the engines. This method is employed instead of electric starting or the use of an auxiliary gasoline engine.

Continuous oil filtering makes it necessary to change lubricating only about every 1500 operating hours, and tests are continuing that may extend even that period.

Inasmuch as engine anti-freeze solution conservation is a considerable factor, a system has been developed for draining the coolant into a 500-gal tank when it becomes necessary to shut down a unit for repair and from this tank pump the fluid back into the cooling system when the repair is completed. This is an important economy measure inasmuch as the cooling system requires 300 gal for each engine. And, of course, anti-freeze is not always available in ample quantities, as has been quite evident during the last several years.

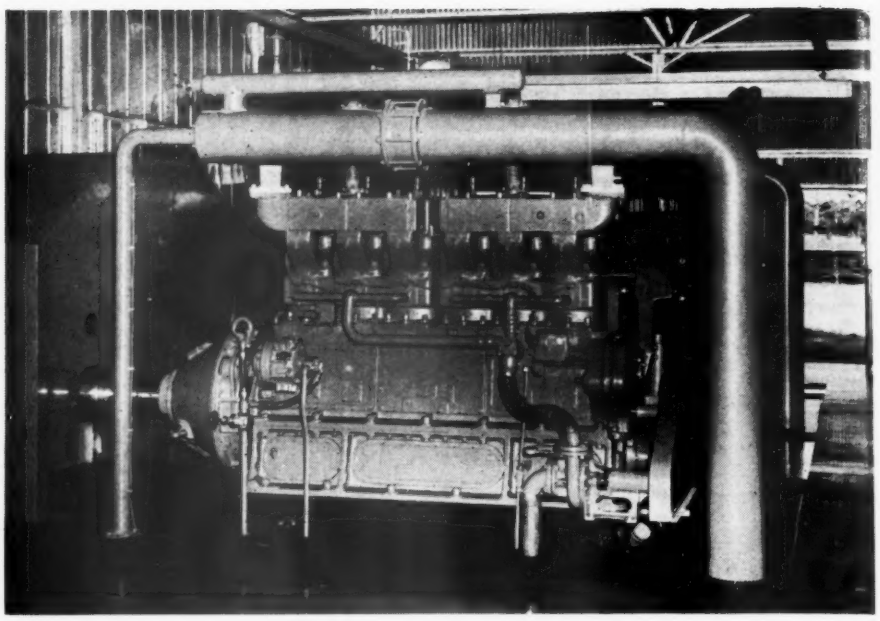
The engines, also, are equipped with the customary safety devices regulating lube oil pressure, engine temperature, pump discharge pressure.

All engine piping is carried in a concrete trench covered with steel plates, the latter in sections to make any part readily accessible. The trench has a vapor-proof drain connected to the regular oil recovery system.

The office building at this station is quite unusual. A separate structure from the one that houses the pumping units, it is constructed of brick and glass, but principally of glass, as can be seen in an accompanying illustration, which provides ample light and gives the men working in the office a clear vision of the entire plant. The panel for the electric gauges, with which all storage tanks are equipped, are in this office building, making it possible for the operator to tell at all times the volume of oil in any or all of the six 55,000-bbl tanks without the necessity for a gauger to measure them individually.

The main station building is a steel frame structure covered with corrugated galvanized iron and measures 35 ft 5 in. by 60 ft 1 in. The floors are of red concrete, with the pigment mixed into the concrete, after which the floor is waxed, giving a serviceable floor as well as an attractive one.

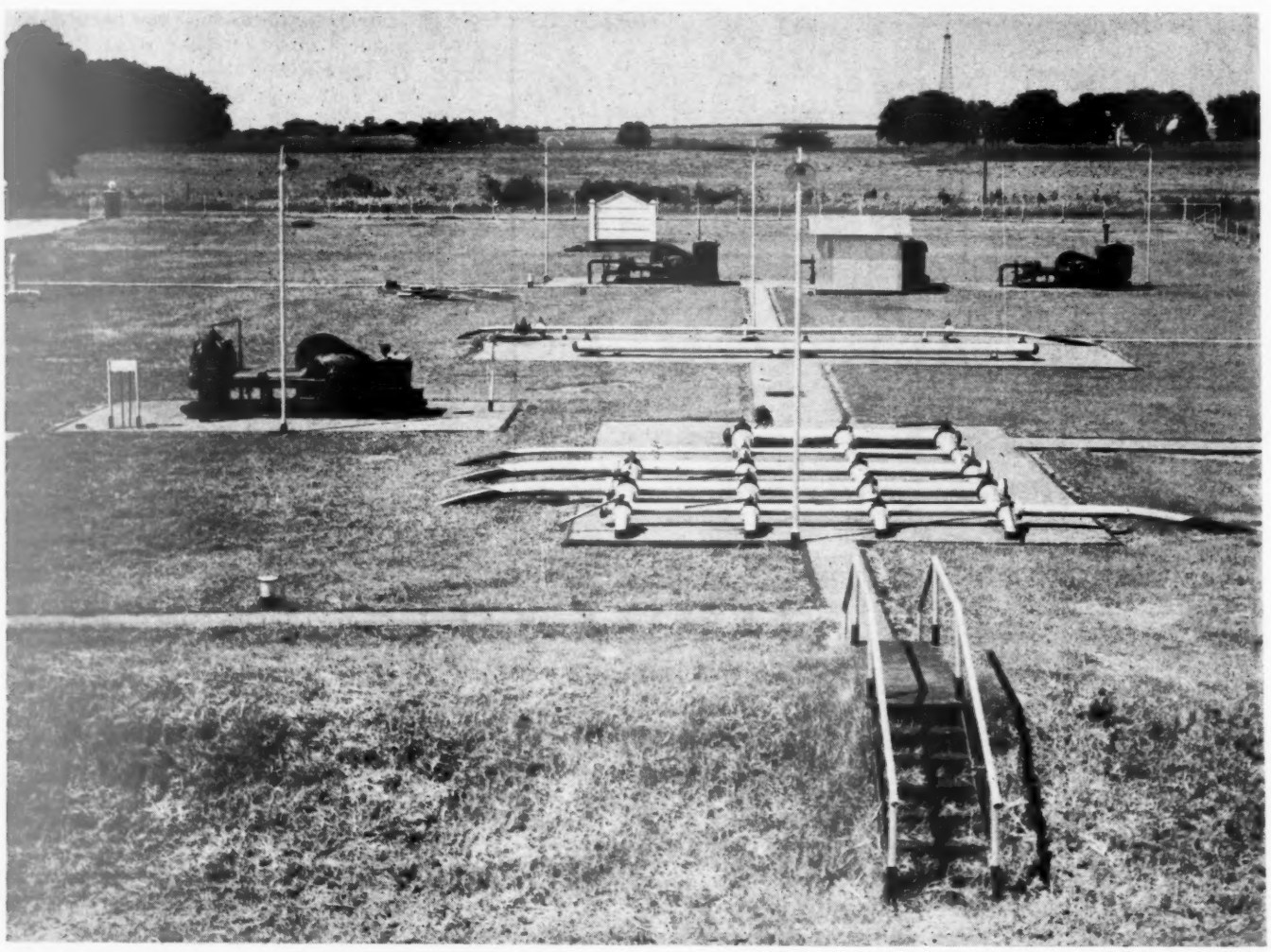
At Bad Creek station there are two 375-hp and one 200-hp gas engines to drive the reciprocating pumps. Maximum capacity of the station is 28,000 bbl a day at operating pressure of 825 psi.

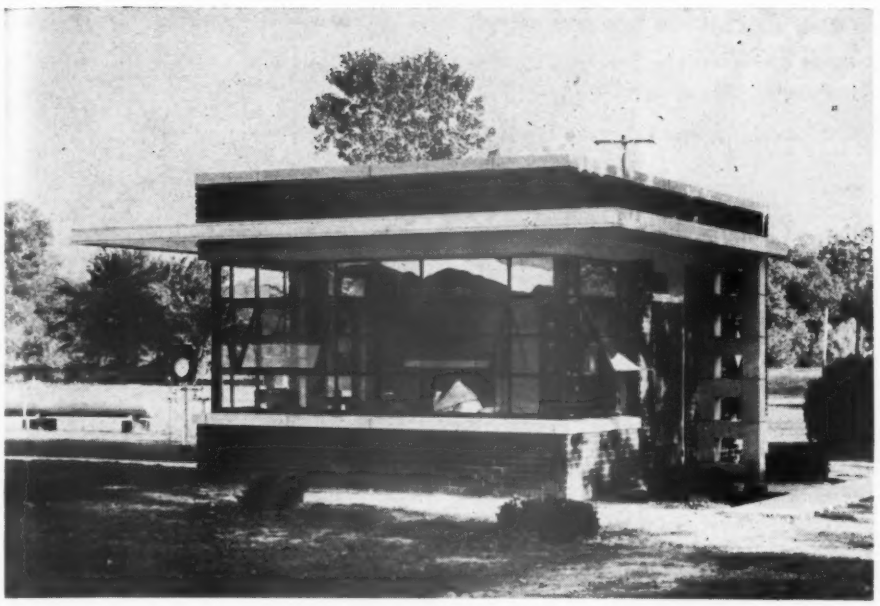


Harris Station. This is one of the fully automatic stations mentioned in earlier paragraphs. Pumping units at this station, which is south of Oklahoma City in the West Moore field, are installed in the open. These consist of two 90-hp and one 100-hp gas engines driving reciprocating pumps. The gauge board containing the suction and a discharge pressure gauges for each unit, as well as a mercoid switch to shut down the engines in case of high pressures, is in a small house immediately adjacent to the pumping equipment. (See illustration.) The front of the galvanized iron building is open; however, a roof overhang protects the panel board from rains. In this building, also, is the starting battery for the engines. These batteries are unusual enough that they merit mention. Known as nickel cadmium batteries, they are just beginning to be used in the pipe line industry, although they have been in use in European industry for some time. As a matter of fact, this is one of the first pipe line stations that has been equipped with the battery. Its features are two: (1) It is self-charging and thus the operator is assured of having sufficient power to start his engines even on winter days, and (2) it is said to be virtually a life time battery.

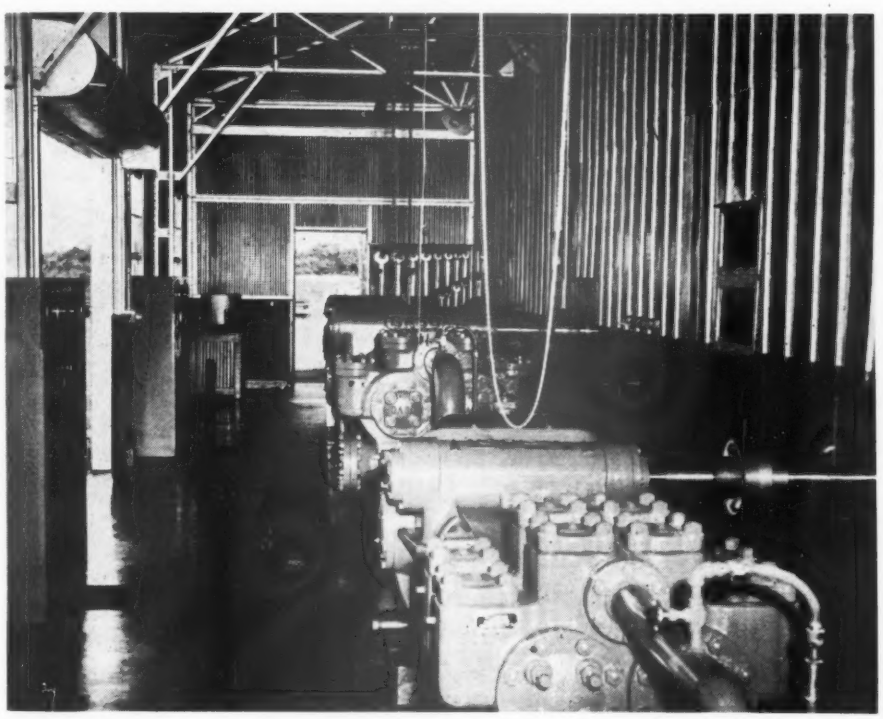
There are three working tanks at

Manifold and suction pump, Harris station. Mid-Continent Pipe Line Company.





The office building at Bad Creek is constructed mostly of glass, providing ample light and giving a clear view of the entire plant.



Reciprocating pumps at Bad Creek. Engine and pumps are connected through a firewall by V-belts and two flexible couplings for each unit.

this station, two 10,000-bbl and one 35,000-bbl, all with floating roofs. A reciprocating pump driven by a 20-hp gas engine pumps from these tanks to the suction of the main line pumps.

Manifold headers are aboveground, as well as all valves, making them more readily serviceable.

▸ **Fitts Station.** The Fitts station, southeast of Ada, is undergoing modernization, which work is nearing completion. A 200-hp gas engine and reciprocating pump has been added. The old pump building was junked and the two existing pumping units (100-hp gas engines and reciprocating pumps) moved to new foundations and aligned with the new pumping unit. These will now operate in the open with no housing. A new gauge house is being built for the operating controls, and a new 10,000-bbl floating tank will supplement the existing two 5000-bbl tanks. All tanks will be equipped with electric tank gauges.

The old underground manifold has been dug up and placed aboveground in keeping with the company's gen-

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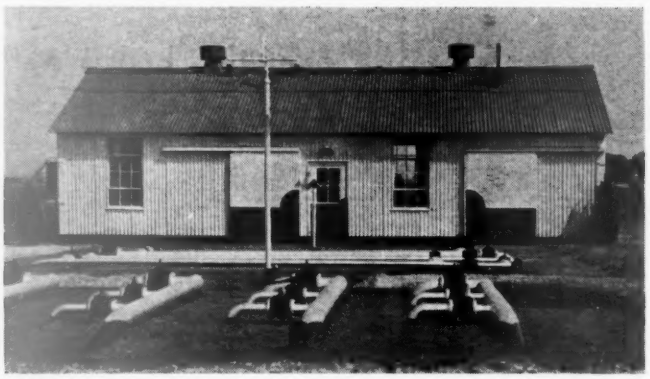
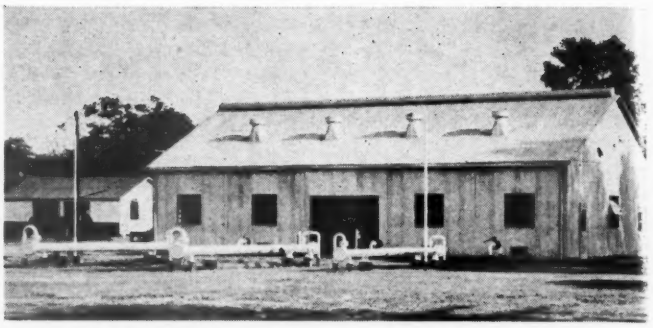
Little Farm station of Mid-Continent Pipe Line at Cushing, Oklahoma, showing suction and discharge manifold.





Bad Creek station building and heat exchangers.

eral practice. In addition to the station work, 17 miles of 4-in. pipe has been laid as a loop between Fitts and Cromwell stations. This station has been pumping 5000 bbl of crude oil a day but under the new set-up will handle 7500 bbl.

▸ **Three Boosters.** New work also has been done at Beggs, Yale, and Fleet. These are all booster stations. The Beggs station consists of two 100-hp motors driving reciprocating pumps and one unit composed of a 375-hp gas engine and reciprocating pump mounted on skids. Station operation is by floating through a tank with a 6-psi head on the pumps. This station is handling approximately 29,000 bbl of crude oil a day at a pressure of 600 psi.

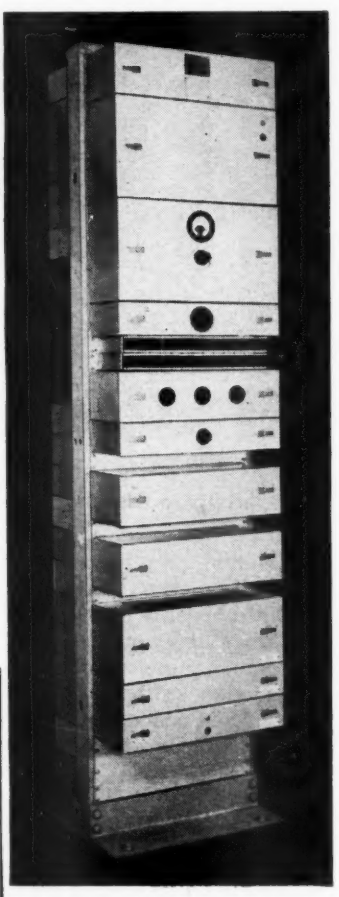
The Yale station has a single pumping unit consisting of 50-hp electric motor and reciprocating pump. There are two 3000-bbl tanks and all piping (from tanks to pumps, manifolds, etc.) are aboveground. A small office building and a warehouse of corrugated-aluminum construction have been built. The station pumps 3000 bbl a day and is fully automatic, being one of the stations that is placed in operation in the morning by a field gauger and shut down by an electric clock at the end of its run.

The Fleet booster station in the Sasakwa field consists of two 4-stage centrifugal pumps driven by a 375-hp (maximum) gas engine.

▸ **Conclusion.** This pipe line system offers a good example of the results that can be accomplised in the way of improved efficiency and increased throughput at reduced operating cost by intelligent and energetic management.

* * *

F-M TELEGRAPH & AUTOMATIC SYNC—on Lenkurt 32 Three-Channel Augmented Carrier



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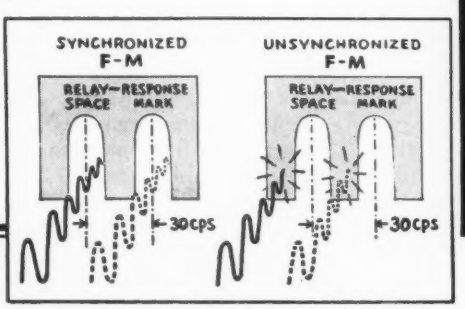

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Many operators who installed UNIBOLT Scraper Traps before the hinge design was available are now converting to the new design by installing the hinges on the job.

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Luther Tolbert

Pipe Line Personality

STRICTLY an outdoor man, both in his work and his hobbies, Luther Tolbert raises white-faced cattle and palomino horses in his spare time; supervises maintenance and new construction on some 4813 miles of pipe line for Lone Star Gas Company in his job as pipe line superintendent for that company.

Born in Hood County, Texas, Tolbert grew up with a flair for ranching and cattle raising. After he graduated from high school in Lipan, Texas, he went into the cattle business and switched to the gas industry only when Lone Star operations came close to his home community. At 28 he took a job with the young organization as a truck driver and when the West Texas line was completed, he remained as assistant pipe line foreman at its KA junction west of Lipan. He was later named district foreman at Mineral Wells and then district foreman at Joshua, closer to Dallas.

In 1927 the company picked him to fill the post of assistant superintendent in charge of pipe line construction and moved him to Dallas. On June 1, 1948, he succeeded R. Vandercook as superintendent of pipe lines.

Mild of manner and soft spoken, the Lone Star pipe lines boss has played an important role in the tremendous and rapid growth of the company which literally "started on a shoe string" back in 1909 when it received its first charter from the state as a pipe line company. Today, with close to 5500 miles of pipe line in both gas company and producing company systems, the organization is a tribute to men like Luther Tolbert who started with them back in the lean years.

A member of St. Johns Methodist church and the Masonic Lodge, he is married and has one daughter, Mrs. A. C. Dudley, Jr., of Dallas.

His ranches, maintained in Parker County, are stocked with Herefords and more than 20 head of palominos. His mother still resides in the family home near Lipan.

Pipe Line Marine Transportation Personals

▸ **H. C. Alton,** superintendent of the Southwest Texas pipe line district of Magnolia Pipe Line Company, was presented with a 30-year service emblem at a foremen's meeting in Alice recently. The emblem was presented by **J. E. McGeath,** assistant general superintendent of Magnolia Pipe Line Company.

▸ **M. O. Thomas,** who is chief inspector for Cities Service Gas Company on the line being constructed by that company from the Hugoton field of Kansas to Hutchinson, will be in charge of maintenance on the system when the line is completed. He will have his headquarters at Pratt, Kansas, where a warehouse will be built.

▸ **F. E. Stanley,** executive manager of Midwestern Constructors, Inc., Tulsa, Oklahoma, headed up the Tulsa Community Chest Campaign as chairman.

▸ **Roy A. Murphy** has been advanced to general superintendent in charge of operations from the Wheaton, Illinois, office of Midwestern Contractors, Inc. He will have charge of all construction gangs doing miscellaneous work for the utility companies in the metropolitan area. Murphy joined the company's supervisory staff in late March and is experienced in pipe line and refinery work. He spent many years with the Atlantic Refining Company and its subsidiaries. In 1943 he became superintendent of operations and maintenance, Division No. 4, for War Emergency Pipelines on the Little Inch pipe line. After the war he went into private business and joined Midwestern Contractors this spring.

▸ **H. P. Ingersoll** has been appointed superintendent of the Massachusetts Products Pipe Line and the Plantation Pipe Line terminals of Shell Oil Company with headquarters in Waltham, Massachusetts. Ingersoll has been with Shell more than 25 years and with the Products Pipe Line Department since 1940 when he became assistant superintendent in the East Chicago terminal, later terminal superintendent there, and in 1946 superintendent of the North Products Pipe Line.

V. K. Leonard has been appointed acting superintendent of the North Products Pipe Line to succeed Ingersoll. Leonard joined Shell in 1939 as a junior engineer at East Chicago. He was transferred to the main office in 1941 and served in various capacities in the Products Pipe Line Department, becoming senior engineer in 1946. Last March he returned to East Chicago as division engineer of the North Products Pipe Line.

▸ **Doyle D. Standlee** has been appointed assistant to **L. H. True,** manager of the Magnolia Pipe Line Company, Dallas, Texas. Standlee was first employed by Magnolia 17 years ago as a proration clerk at Greggton, Texas. He was advanced to chief clerk of the East Texas district in 1934 and,

Doyle D. Standlee

after serving in that position for five years, was transferred to Vandalia, Illinois, to aid in the construction of the company's 10-in. crude oil pipe line from East St. Louis, Illinois, to Lima, Ohio. In September, 1939, he was moved into the general offices at Dallas and made administrative assistant in the assistant manager's office.

Continued on Page 305

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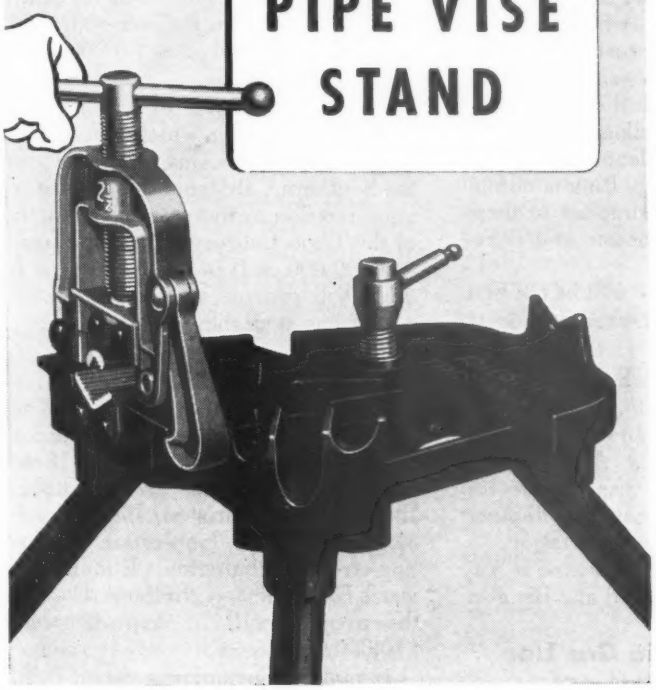

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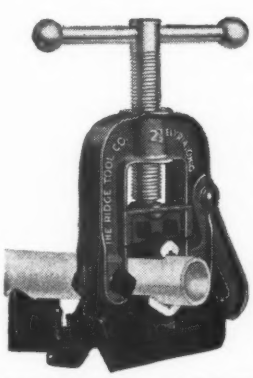

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PIPE LINE

Atlantic Plans 382-Mile Line

Plans for the construction of a 382-mile crude oil pipe line from the West Texas Permian Basin to the lower Gulf Coast have been announced by the Atlantic Pipe Line Company.

John H. Wood, Dallas, Texas, vice president of the company, said construction of the 10-in. common carrier would begin about January 1 when first shipments of the line pipe are expected.

The line will extend from the Block 31 field in Crane County southeast to a point near Refugio. At the latter end, the line will tie in with Atlantic's system for movement of the oil to the company's water terminal at Harbor Island near Aransas City.

At the West Texas end, the line will be linked with the company's existing pipe line system, terminus of which is at Midland. Atlantic already has a 10-in. line extending to the coast from Midland, moving crude at the rate of 47,500 bbl a day to Atreco, near Beaumont.

Initial capacity of the new line will be 20,000 bbl a day. Addition of pump stations can more than double this capacity. Present plans call for a single pump station at the Block 31 terminus. There is a 3000-ft drop in elevation from the West Texas end to Refugio.

Preliminary work for the project has been under way for some time. Aerial survey of right-of-way already has been completed, and a land survey begun. Contracts are to be let soon for laying of the line.

Products Lines Near Completion

Two new pipe lines being constructed by Socony-Vacuum Oil Company, Inc., one from Malvern, Pennsylvania, to Binghamton, New York, and the other from Portland to Bangor, Maine, are being pushed to completion and should be finished before the onset of winter, the company announces. Each is approximately 60 per cent completed.

The Malvern-Binghamton line is scheduled to be ready by November 15 and the Maine line by December 1.

To hasten the work, Socony-Vacuum recently added a crew of 200 men to each pipe line, in addition to the 200 who have been working on each line.

The Malvern-Binghamton line, which will be 154 miles long and 8 in. in diam, will transport home heating oils, gasoline, and kerosine from the company's refineries at Paulsboro, New Jersey, and from those in Upper New York State to bulk storage facilities at Reading, Allentown, Exeter, and Hazleton, as well as Binghampton. It will also expedite supplies of these products in the Rochester and Syracuse areas.

The Maine pipe line will be the first in the state to carry finished petroleum products.

The new line, which is 124 miles long and 6 in. in diam, will facilitate deliveries of gasoline and heating fuels to communities in the Auburn, Augusta, and Bangor areas despite ice and snow conditions that often hamper overland and water transportation.

Storage terminals are located at Auburn-Lewiston, Hallowell and Bangor.

Propose California Gas Line

The Southern Counties Gas Company and the San Diego Gas and Electric Company have filed applications with the California Public Utilities Commission for permission to construct a 95-mile pipe line connecting the San Diego company's distribution system with the Texas-California natural gas transmission line.

The project, which it is estimated will cost in the neighborhood of $5,000,000, will increase the maximum daily supply of natural gas available to the San Diego County area from its present 33,000,000 cu ft to approximately 73.000,000 cu ft. Thirty-five miles of the proposed line is to be constructed by Southern Counties Gas Company in Riverside County with the rest to be built by the San Diego Gas and Electric Company in San Diego County. It is proposed to begin construction on the line by January, 1949, so that, if possible, it may be completed in time for the heavy gas demands of winter months in 1949-50.

The proposed 16-in. transmission line would run from a point near Moreno on the "Biggest Inch" section of the Texas-California pipe line, to San Diego. The present supply of natural gas to this area comes through a 90-mile pipe line tapping the Southern Counties Gas Company's transmission system at Huntington Beach. Since 1932 this has been the sole source of supply of natural gas for the San Diego company.

The recent action of the Federal Power Commission, which granted the Southern Counties Gas Company and the Southern California Gas Company authorization to increase the capacity of the Texas-California pipe line from 305,000,000 cu ft to 405,000,000 cu ft daily will provide an additional supply of gas available for this use.

Illinois Crude Oil Line

Plans have been revealed by The Texas-Empire Pipe Line Company for the construction of 183 miles of 18-in. crude oil pipe line from Patoka, Illinois, to Wilmington, Illinois, and 31 miles of 16-in. loop crude oil pipe line from Wilmington, Illinois, toward East Chicago, Indiana. Cost of the project will be approximately $10,000,000.

In making the announcement, R. B. McLaughlin, president of the company, stated that the project includes a modern type diesel pump station and nine 120,000-bbl capacity tanks at Patoka; and a new modern type motor-operated station and six 120,000-bbl capacity tanks at Wilmington.

McLaughlin stated that the new facilities will provide efficient and economical flow of a large volume of crude oil from the West Texas-New Mexico and the Mid-Continent areas to the Midwest refining area to assist materially in providing raw materials so that the refineries can operate at the maximum capacity to meet the ever-increasing consumer demand for petroleum products.

Nominal capacity of the 18-in. line between Patoka and Wilmington, with the initial pump stations, will be 69,000 bbl per day, which subsequently can be increased to 104,000 bbl per day by the installation of a booster station. Construction of this section of line is scheduled to begin early in 1949 and to be completed into Wilmington by September 1, 1949.

Construction of the 16-in. line from Wilmington toward East Chicago will be undertaken early in the spring of 1950. A contract has been awarded for the tank grade work at Wilmington,

PROJECTS

and a contract will be awarded in the near future for tank grade work at Patoka.

Contracts will be awarded about the first of the year for erection of the pump station at each of the locations.

The new system will connect with the new 22-in. pipe line of The Texas Pipe Line Company, which is scheduled for completion into Patoka by May, 1949, and will provide additional facilities for the transportation of West Texas-New Mexico crude that will originate in the Jal-Cushing project now under construction; and move thence through the new 22-in. line from Cushing, Oklahoma, to Wood River, Illinois, which will be constructed this fall and winter, and from Wood River to Patoka through the 22-in. pipe line, wholly owned by The Texas Pipe Line Company.

The Jal-Cushing pipe line system is owned on an undivided interest basis by The Texas Pipe Line Company, Shell Pipe Line Corporation, Sinclair Refining Company, and Empire Pipeline Company. The Cushing-Wood River pipe line is owned and will be operated on an undivided interest basis by the Shell Pipe Line Corporation and The Texas Pipe Line Company.

To Increase Line Capacity

The Federal Power Commission has authorized Northern Natural Gas Company of Omaha, Nebraska, to construct and operate new natural gas facilities designed to increase daily delivery capacity of its transmission system north of Clifton, Kansas, by 45,000,000 cu ft.

The proposed construction includes approximately 28-½ miles of 24-in. pipe, 17 miles of 20-in. pipe, and seven compressor units with an aggregate of 11,200 hp. The facilities are to be built along Northern Natural's existing pipe line system, which extends from gas fields in Kansas, Oklahoma, and Texas to the Minneapolis-St. Paul area. Estimated overall cost of the facilities is $4,311,000.

Installation of the facilities, together with construction of other facilities authorized by FPC, will bring delivery capacity of the system north of Clifton, Kansas, up to a total of 470,000,000 cu ft a day, the company said.

Submarine Lines Authorized

The Federal Power Commission has authorized Texas Gas Transmission Corporation to construct and operate two 12-¾-in. submarine pipe lines across the Mississippi River near Greenville, Mississippi, and to substitute 11,000 ft of 26-in. pipe for 9000 ft of 18-in. pipe previously authorized as an extension of the approaches to an existing underwater crossing of 14-in. pipe near the same point.

In its application, Texas Gas said completion of the proposed facilities would insure its Memphis division customers against "extended failure" of gas supply during the coming winter in the event the changing course of the Mississippi should result in loss of any of the existing submarine crossings. The company now has three 10-in. submarine lines and one 14-in. submarine line, which broke early in 1948 and is now under repair. Overall cost of the project is estimated at $360,000.

Preparing Tank Farm Site

A contract has been let by The Texas Pipe Line Company to Tulsa Engineering and Construction Company, Inc., Tulsa, Oklahoma, for construction work preparing the site of Cushing tank farm, eastern terminus, of the Jal, New Mexico-Cushing, Oklahoma, pipe line, it was announced by R. B. McLaughlin, president of the pipe line company.

The contract provides for construction and installation of tank grades, levees, roadways, drainage ditches, and culverts at the tank farm site, which is 1½ miles south of Cushing. Work will begin immediately.

To Install Compressor Units

The Federal Power Commission has granted Atlantic Seaboard Corporation temporary authority to construct and operate two 800-hp gas engine compressing units at a new station near Hanover, West Virginia. Atlantic Seaboard's application said the installation would increase natural gas deliveries from eastern Kentucky and southern West Virginia 8,000,000 cu ft a day at the Rockville, Maryland, measuring station, the point at which gas is sold to Washington Gas Light Company.

Atlantic Seaboard estimated the total cost of the units and appurtenant equipment at $480,000. Construction is scheduled to begin at an early date in order to complete the compressor facilities for increased natural gas deliveries this winter, the company said.

Would Add to System

Southern Natural Gas Company is seeking Federal Power Commission authorization to construct and operate additional main and branch loop lines in Alabama for transportation of natural gas. Estimated cost of the project is approximately $865,000.

Proposed facilities include approximately 8½ miles of 24-in. main line loops, 9 miles of 12-in. branch line loop pipe, and a three line 12-in. crossing of the Coosa River. Southern Natural said construction of the main line loops would increase capacity of the portion of its pipe line system between Birmingham, Alabama, and Atlanta, Georgia, thus providing greater flexibility of operation. The proposed branch looping line is designed to increase delivery capacity of the company's Montgomery branch line by approximately 3,500,000 cu ft a day.

Seek Transfer of Facilities

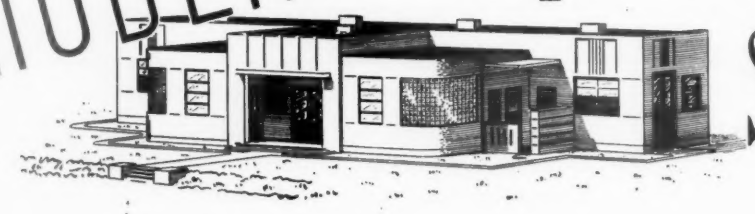
Trans-Continental Gas Pipe Line Corporation, a Delaware corporation, is seeking Federal Power Commission authorization to acquire, construct, and operate proposed facilities of Trans-Continental Gas Pipe Line Company, Inc., incorporated in Texas, and to succeed to all other rights and obligations of the Trans-Continental Company under the commission's jurisdiction.

The Trans-Continental Company was authorized by FPC May 29, 1948, to construct and operate a natural gas transmission system extending from New York City, and currently is seeking an amendment to the commission's order, authorizing the company to substitute 30-in. pipe for 1210 miles of the 26-in. pipe previously authorized. Total cost of the project is estimated at $189,810,154.

The Trans-Continental Corporation said there would be no change in management and no increase in operating expenses or in cost of service would result if FPC approves the "change in the state of incorporation."

P 615.92

MODERN Pipe Line STATIONS



Hebert, Initial Station on Products Line

By FRANK H. LOVE*

HEBERT station of Magnolia Pipe Line Company is the initial station on the products pipe line system from Beaumont-Port Arthur to the Dallas-Fort Worth area, Texas. Magnolia Pipe Line Company operates the line to Hearne, Texas, and The Texas Pipe Line Company from that point to its terminus at Dallas and Fort Worth. Products are received at the Hebert station from the Beaumont refinery of Magnolia Petroleum Company and from The Texas Company refinery at Port Arthur. At present the products transported are premium and house-brand gasolines and kerosine. Eventually diesel fuel also will be pumped through the line.

The Port Arthur refinery is about 10 miles to the south of the station and the Beaumont refinery approximately 6¼ miles distant. The station site itself is a 68-acre tract 5 miles from the city limits of Beaumont on the old Port Arthur highway. Products are metered as they leave the refineries and are also metered in at Hebert station. Average capacity of the line from Port Arthur is 1500 bbl an hr and that from Beaumont 1100 bbl an hr.

Arriving at Hebert station products are passed through "hay tanks," one on each line, to drop out any foreign matter that may be present. Foreign matter that the "hay tanks" do not take out passes through 100-mesh filter screens ahead of the meters, and from that point the product flows directly to the storage tanks. Meters, incidentally, are calibrated by means of a master meter, the latter in turn being calibrated by a calibration tank.

The tank farm consists of six 80,000-bbl and one 55,000-bbl tanks, all floating roof type, there being a separate tank for each product and a separate line for each product from the manifold to the tanks. These are 12-in. lines and the same line is used for filling and suction. The lines are above ground on concrete and pipe supports, making them less subject to corrosion and readily accessible for repair in event of leaks. These lines have expansion joints at various points to compensate for expansion and contraction. Just outside the firewall of each tank is a booster pump, consisting of a 30-hp motor-driven centrifugal unit, which is remotely controlled from the station by push buttons, and a three-way check valve that makes it unnecessary to change gates to pump into or out of a tank.

Each line has a relief valve at the tank, set at 15 psi, which takes care of bottled pressure in the line. Another feature is that all tanks have an individual automatic gauge, read at the base of the tank.

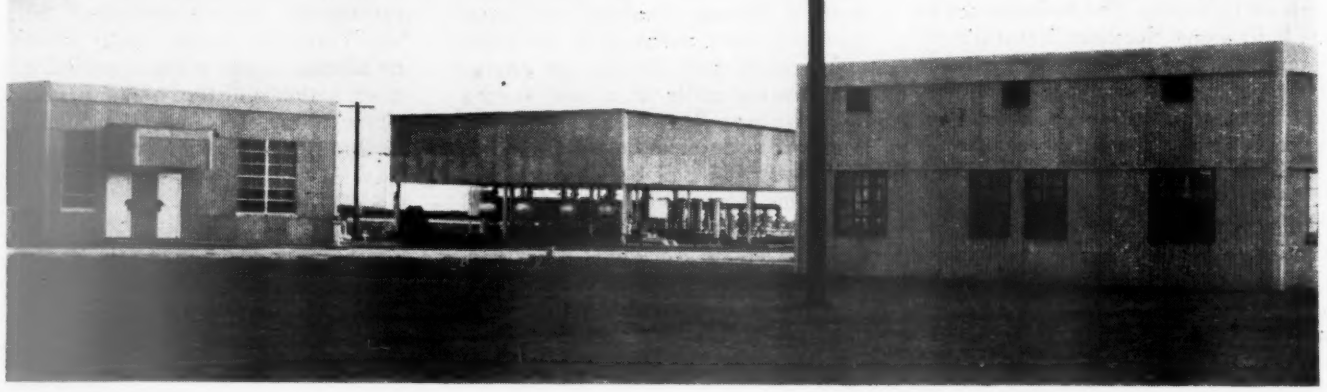
Four of the 80,000-bbl tanks are equipped with small sumps in the bottom of the tanks so that they can be pumped practically dry. The sump from which the pump can take suction is 4 ft in diam by 2 ft deep.

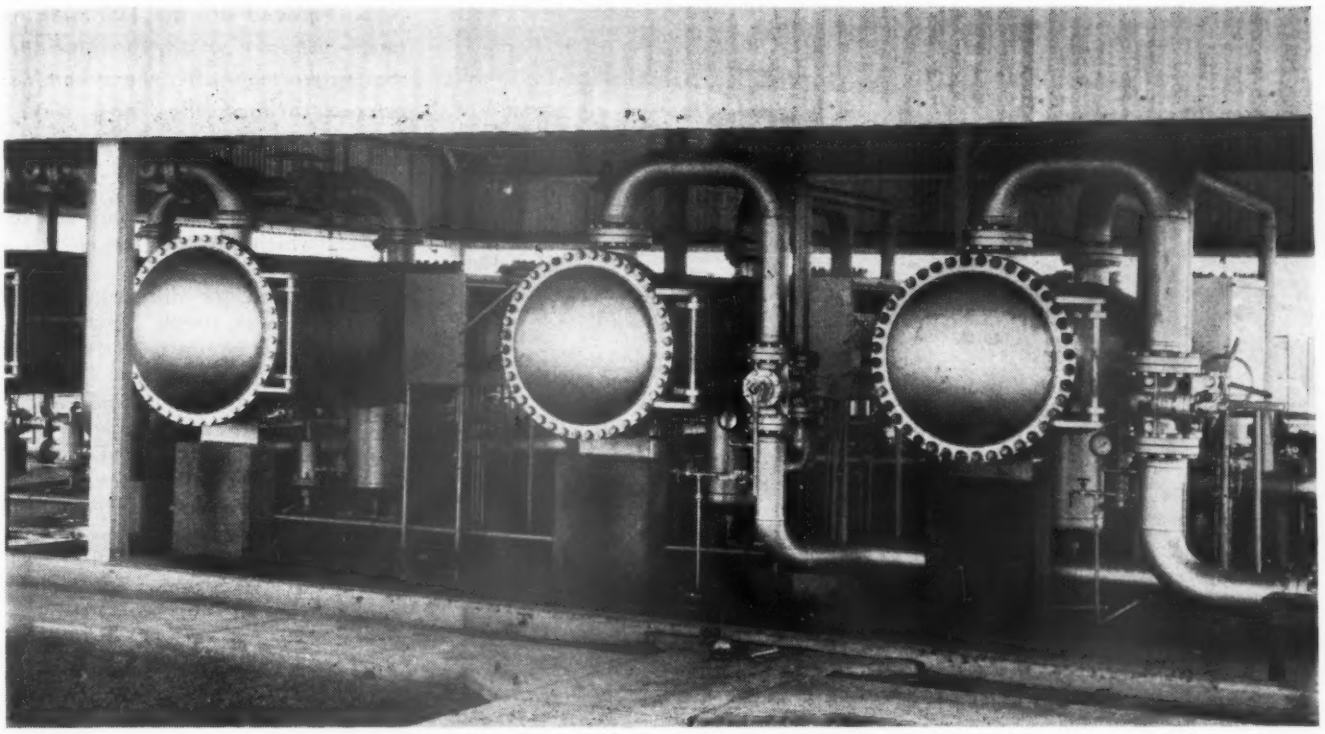
Products for transportation north of the main line from Hebert to Hearne are pumped from the storage tanks through another set of "hay tanks" and 100-mesh filters before entering the meters and from that point to the suction of the main line

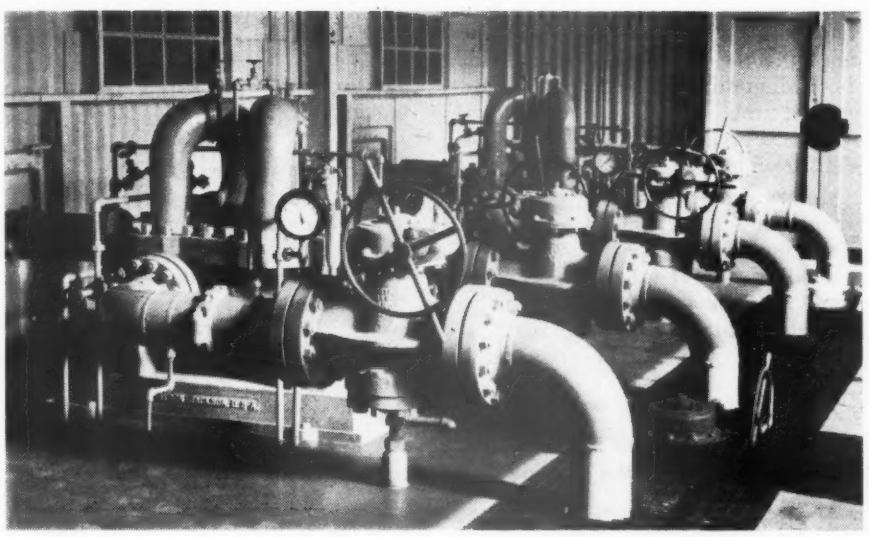
*Pipe Line and Marine Transportation Editor.

EXCLUSIVE

All buildings are covered with corrugated transite. At left is pumphouse, in center is shed-type building housing manifold, "hay tanks," filters, and meters, and at right an office building.







A "hay tank" on each incoming line is for the purpose of dropping out any foreign matter that may be present in the stream.

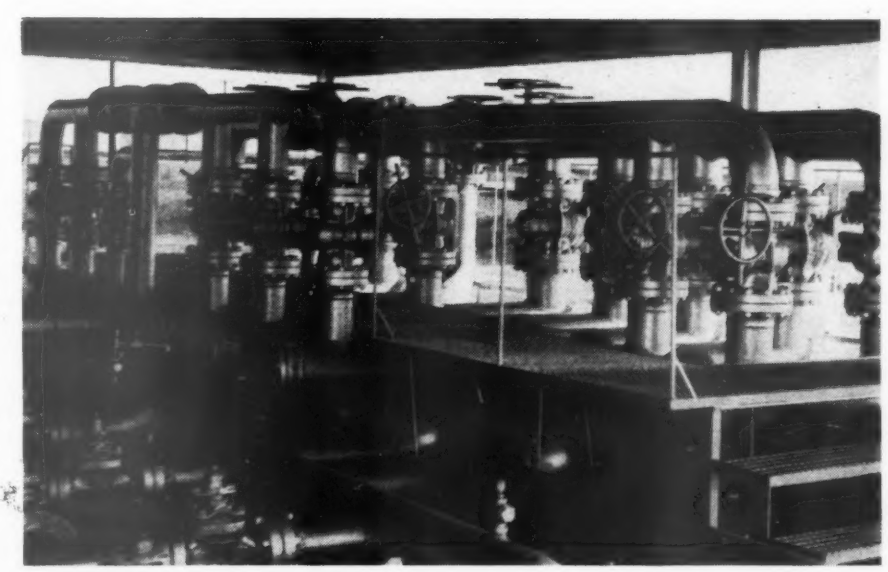
Main line pumps consist of two 6-in. by 8-in. centrifugal units, which are driven by 400-hp motors. Suction pressure is 40 psi and discharge pressure 500 psi.

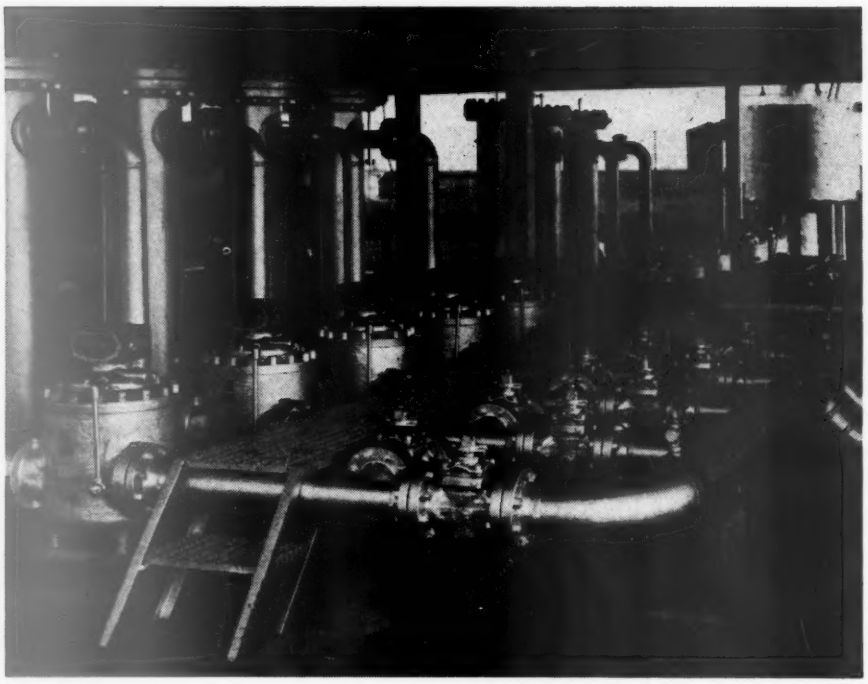
Manifold for handling products into and out of the tankage.

pumps. There are two 6-in. by 8-in. centrifugal pumps driven by 400-hp motors. The suction pressure is approximately 40 psi and discharge pressure approximately 500 psi when only one unit is in operation.

The 400-hp motors have extended shafts and drive the pumps through outboard bearings and flexible couplings. These motors have standard thermo-switches in the bearings and fields, which are connected to shut-down the unit and flash red lights to indicate the trouble. The motors are push button started through unitized, metal clad, dead front, totally enclosed compensators, and can be stopped from three emergency push buttons placed at easily accessible non-hazardous locations.

Hebert station is pumping 178 miles





In background are the 100-mesh filters, which take out any foreign matter that may remain after the stream has passed through the "hay tanks." In front of the filters are the meters.

to Hearne, with a 6-in. takeoff at Aldine Junction north of Houston.

A gravitometer has been installed on each incoming and outgoing stream at Hebert station. In conjunction with the gravitometers a hydrometer well and color bulbs also are provided. Thus there are three means of determining change in product being shipped or received. The color bulbs provide a visual means. Gravity change is shown by use of the hydrometers, and the gravitometers give a continuous means of determining a change.

On the main line at Aldine Junction a hydrometer well and color bulbs have been installed to show change in batches. On the 6-in. line supplying the two Houston terminals (both Magnolia and Texas have terminals at this point) gravitometers, hydrometers, and color bulbs all have been provided.

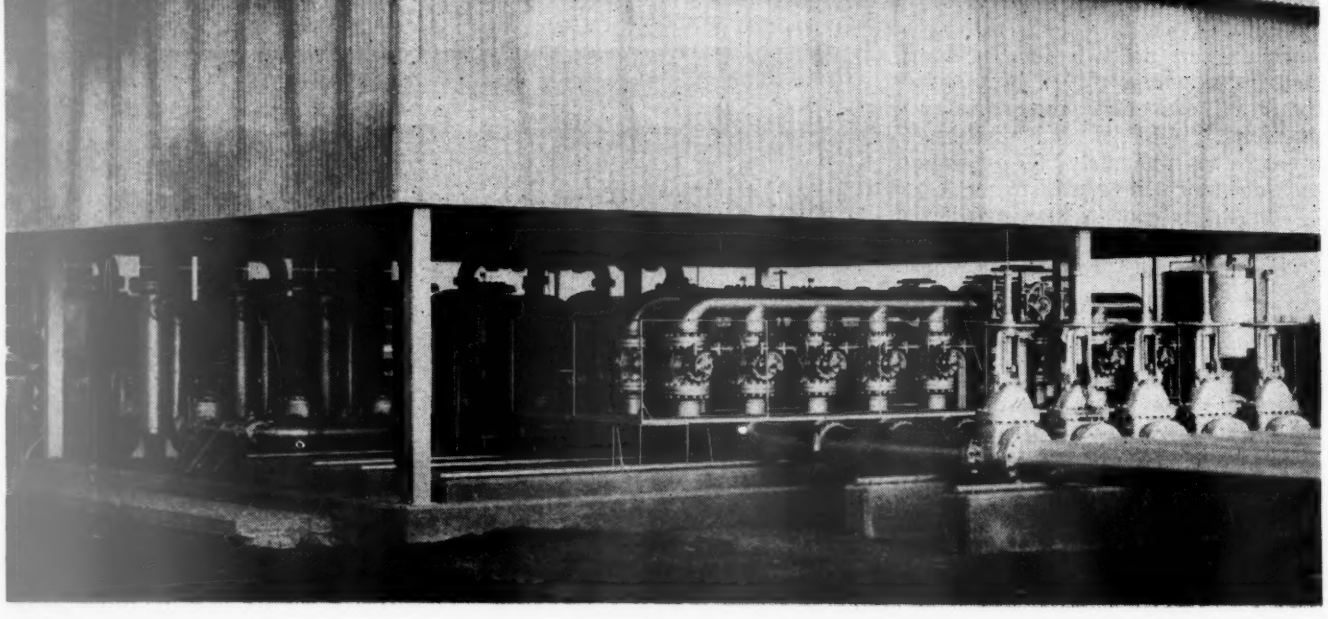
Motors and pumps are connected through a sealed firewall. Inasmuch as the motors are not explosion-proof, an exhaust blower takes air from the pump room and draws fresh air in through air filters, removing any possible vapors and de-pressurizing the pump room. The motor room and office are pressurized by means of a blower, which protects the electrical equipment.

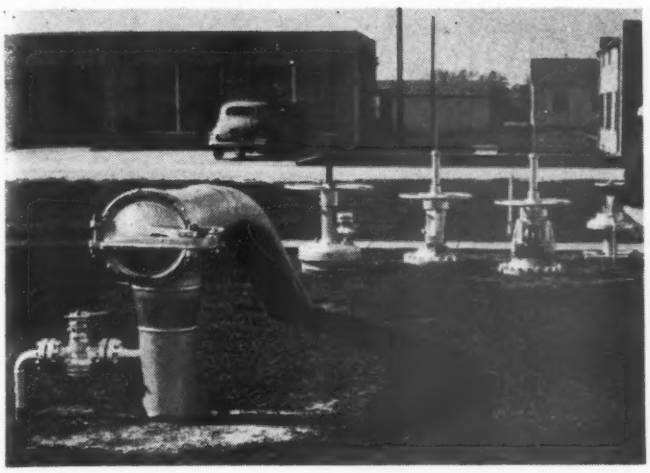
Sampling of the different batches for quality is thorough. Shortly after a new product begins to arrive at the station, a sample is taken. A second sample is taken in the middle of the batch and a third near the end. After delivery has been completed, two additional samples are taken, one a check sample or for reference, the other to be analyzed.

Safety factors also have been well considered. Air-actuated controllers regulate the suction and discharge pressures of the pumps, and mercoid switches are provided to shut the main pumping units down in event discharge pressure becomes too high or suction pressure too low. Ample fire-fighting equipment also is provided in the form of extinguishers of varying sizes. These consist of three 150-lb units at strategic points throughout the plant grounds, four 30-lb extinguishers in the manifold, one 30-lb unit in the garage, one 30-lb at each booster pump, and three 30-lb extinguishers in the pump room.

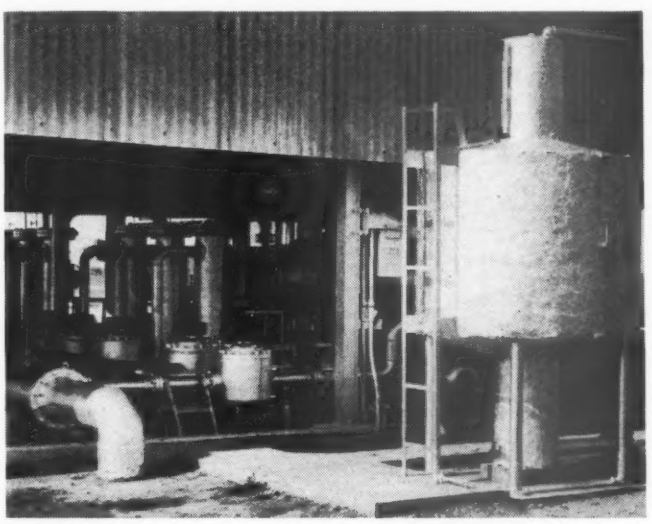
The main station building, which contains the motor and pump rooms, office, and bath, measures 36 ft by 60 ft. This is divided as follows: Pump room, 43 ft 6 in. by 18 ft 6 in.;

This building, which houses the manifold, "hay tanks," filters, and meters, has a shed-type roof with sides and ends open from the ground to a height of 10 ft. Ventilation is provided at the roofline also. Accumulation of vapors is thus avoided.





Scrapers are run through all lines once a week. This includes lines between the two refineries and Hebert station, as well as the main line. Jet rotation type scrapers are used.



In right foreground is the calibration tank. The master meter is calibrated by this tank. All other meters are calibrated by means of the master meter.

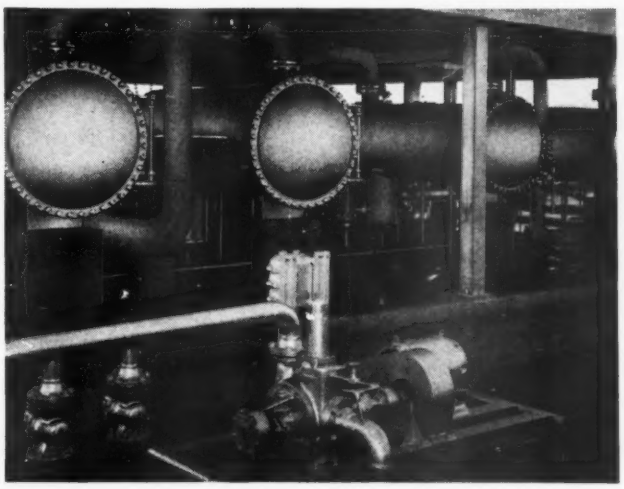
motor room, 43 ft 6 in. by 16 ft 6 in.; office, 22 ft by 15 ft 2 in., and bath, 15 ft 2 in. by 12 ft. All buildings are of steel construction with corrugated asbestos siding and fireproof material is used throughout the design. Explosion-proof motors and lights are installed in vapor areas.

The building that houses the manifold, "hay tanks," filters, and meters, has a shed type roof with the sides and ends open from the ground to a height of 10 ft. Ventilation is provided at the roofline, which, together with the open sides and ends, prevents possible accumulation of vapors. This housing arrangement has the feature that the vital equipment mentioned is all under one roof, out of the weather, and above ground.

A warehouse 43 ft by 25 ft is used for storage with a considerable space allotted for meter maintenance and other repair work. A 5-stall garage adjoins the warehouse on the south. One house is provided on the property for the station chief engineer.

In addition to the office space provided in the station building itself, there is another office structure, 38 ft by 36 ft, which has 5 offices and a store room. ★ ★ ★

EXCEL-SO separators remove water, scale and rouge for Magnolia Pipe Line Company . . .



● **PROBLEM:**

To remove water, scale and rouge from product streams of gasoline and kerosene at the Hebert Products Pipe Line Station.

● **EQUIPMENT USED:**

Two Model HP-750 and two HP-1000 Excel-So Separators.

● **RESULTS:**

The two 750 gallon units are on the incoming side and the two 1000 gallon units are on the suction side of the main line pumps. These units handle both gasoline and kerosene. All four separators are successfully taking out all appreciable water in addition to removing all appreciable scale, oxides, rouge, etc., that are detrimental to the pumps and other equipment.

For information regarding how Excel-So Separators can solve your separating problems write . . .

WARNER LEWIS COMPANY

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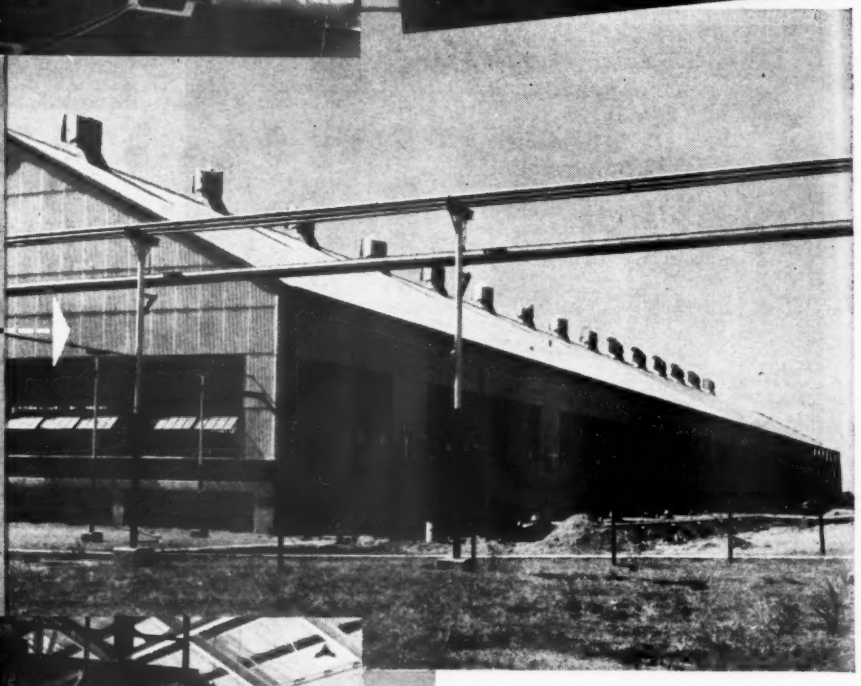
Leading

WORTHINGTON HORIZONTAL GAS ENGINE COMPRESSORS WILL TOTAL 135,200 ICHP

Photos taken at one of the country's largest compressor stations — the Stinnett, Texas, plant of the Texoma Natural Gas Company, a company affiliated with the Natural Gas Pipeline Co. of America. Interior views show Worthington Horizontal Gas Engine Compressors (24" x 36", Twin Tandem, 1400 HP each) in process of installation. Starting with 57 of these in 1931, the company will have 104 Worthington units of various types by 1949—for a total of 135,200 ICHP!



Worthington "Angles"

Throughout the oil and gas industries Worthington LTC Angle Gas Engine Compressors are famous for cost-saving, uninterrupted gas-transmission. In refrigeration, and in chemical and other processes as well, this ability of LTC's to carry full loads "around the clock" is proving to a wide range of users that *there's more worth in Worthington* . . . Five sizes of cylinder combinations, 400 to 1000 HP. Write for Bulletin L-690-B1.

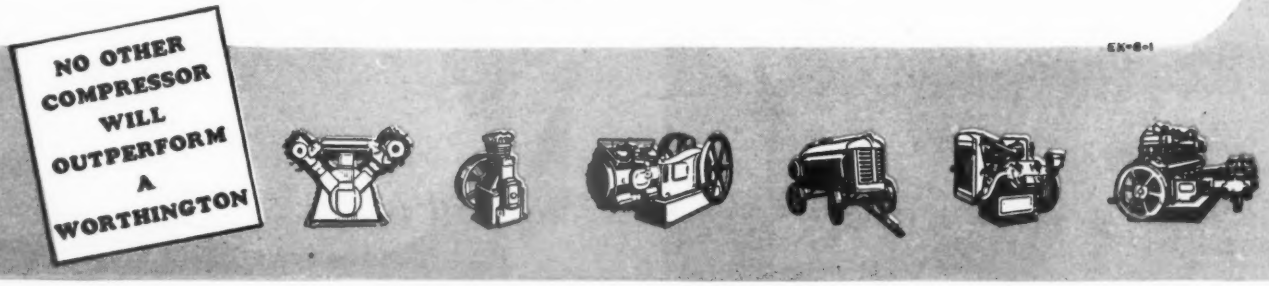
pipeline company adds **ANOTHER** *Worthington mass-installation!*

The Natural Gas Pipeline Company of America, since its formation in 1931, has made Worthington units key factors in an outstanding expansion program. By 1949, this will include a line-capacity of 484 million cu. ft. per day—almost triple the original volume!

Case histories like this—and Worthington can show you plenty of them—point to facts vital to every user of power or compressor service. Such reorders for multiple installations can only come from complete confidence—based on years of "living with" Worthington equipment, checking continuously on its dependability and economy, comparing it with competitive units.

That's why it will pay you—whether you need one engine or a battery of them—to look further into the many advantages of Worthington Horizontal Gas Engine Compressors. Write for information. *Worthington Pump and Machinery Corporation, Engine Division, Buffalo, New York.*

WORTHINGTON



PIPE LINE PIC

Photo courtesy Standard Oil Company (N. J.)

From Elk Basin, Wyoming and Montana, the Yale pipe line was laid to Billings and Laurel, Montana. In background is machinery ready to fill the ditch.

Maurice Williams of Anderson Brothers awards a bowling trophy to Mrs. Alice Olson, captain of a Tennessee Gas Transmission Company's team. With Mrs. Olson are Sally Johnson, Betty Harrell, Lynda Brown, and Williams.

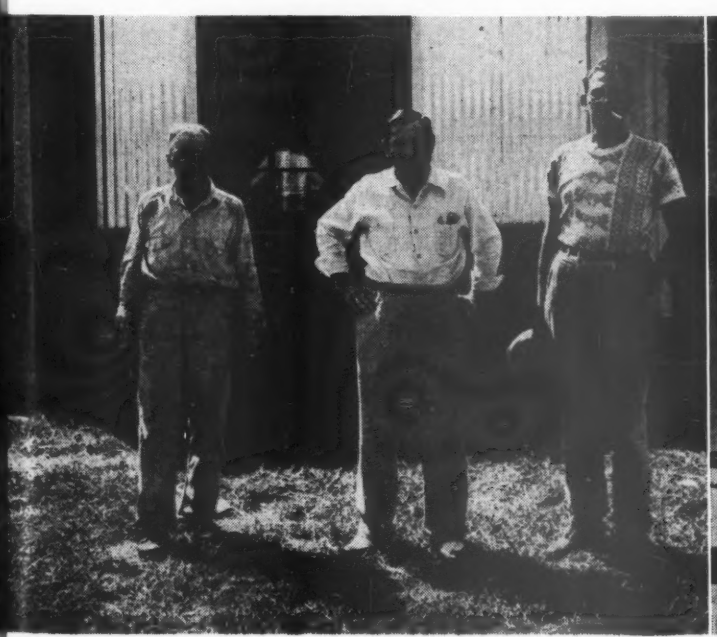
TGT officials at a barbecue in Natchitoches, Louisiana, given by Lions, Kiwanis, and Rotary clubs. Above, Charles S. Coates, superintendent of operations, Mayor Frank Kees, and Voris King, Rotary vice president. Below, M. L. Dudney, land department; John Tarpley, construction engineer, and O. H. Moore, assistant superintendent.

Officials of the North Texas NACE: C. I. Sims, Corrosion Engineering Service, secretary-treasurer; Tom D. Statham, Magnolia Pipe Line, chairman, and J. A. Clay, Jr., Service Engineers, Inc., vice chairman.

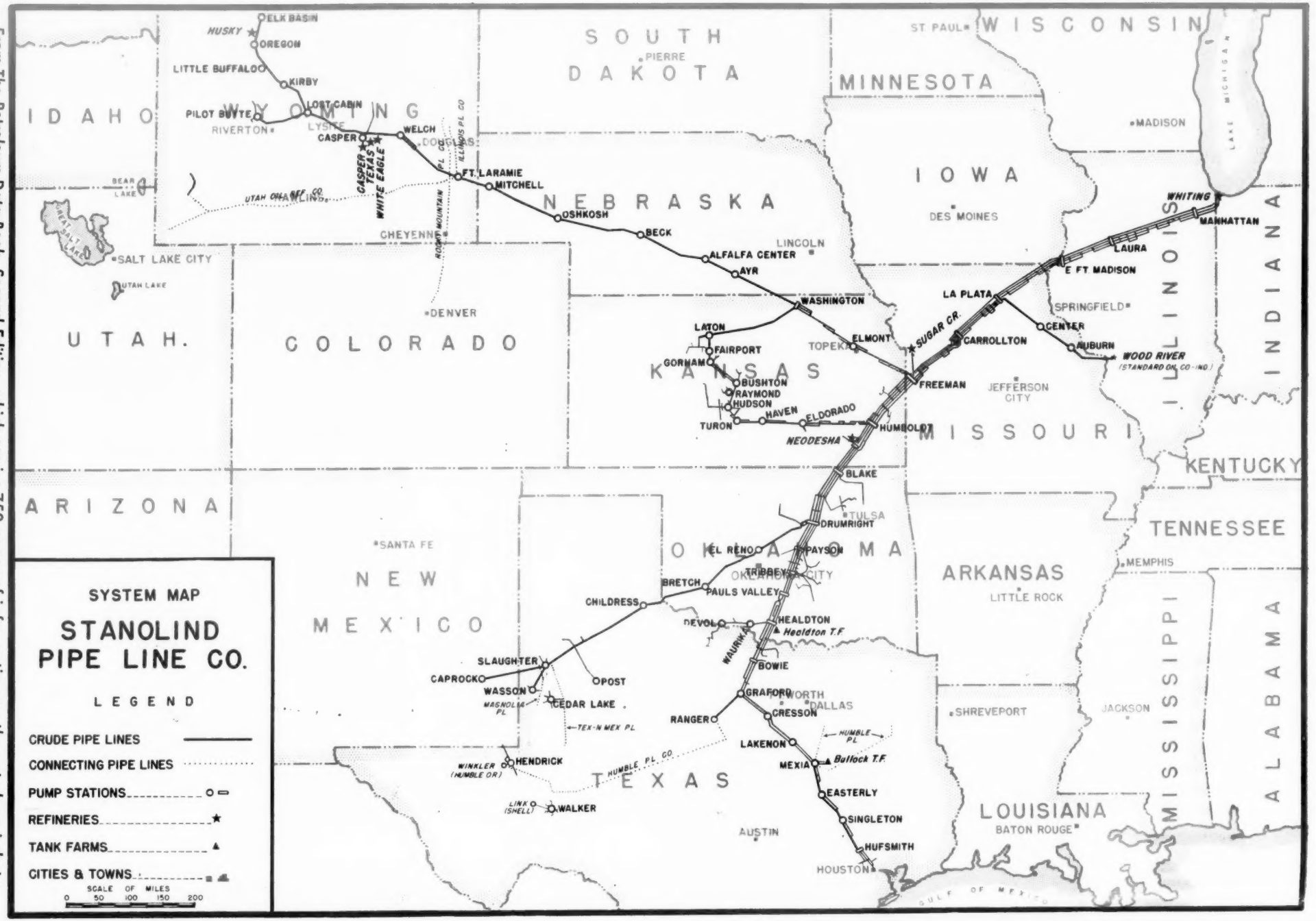
PICTORIAL

This somewhat unusual photograph was taken on the system of the Humble Pipe Line Company north of Satsuma, Texas, in the Gulf Coast area. It shows the modern-day "linewalker" patrolling one of the company's older lines by air looking for leaks while a new line is being laid parallel. Within recent years inspection by air has largely superseded the earlier day linewalker whose means of locomotion was by foot or on horse.

Tom Price, linewalker; Al C. Smith, superintendent of mechanical maintenance, and F. P. Brown, field gauger, for Mid-Continent Pipe Line Company. Photo was taken at Harris station in West Moore field, Oklahoma.



Magnolia Pipe Line Company men taken at Hebert, Texas, station on new products line. They are: J. J. Harris, chemical engineer; R. L. Phillips, assistant district superintendent, and M. R. Anderson, chief engineer of Hebert station.



From The Petroleum Data Book, Second Edition, which carries 750 pages of information on the petroleum industry.

PERSONALS

Continued from Page 290

▸ **J. T. Robb,** assistant secretary and assistant treasurer of Great Lakes Pipe Line Company, Kansas City, Missouri, since 1921, was elected controller at a recent meeting of the board of directors. **G. A. Welsh** was promoted from the accounting department to Robb's former position.

▸ **R. M. Sackett,** division superintendent of The Ohio Oil Company pipe line department at Casper, Wyoming, since 1945, has requested to be

Jack H. Rice

relieved of the responsibilities of that position because of ill health, the company announces. **Jack H. Rice,** formerly assistant division superintendent, has been appointed division superintendent to succeed Sackett.

Sackett will continue his employment with the company and has been appointed assistant division superintendent. Rice was employed by the company in 1930 in West Texas. After advancing through numerous positions he was made assistant division superintendent at Casper in 1944.

▸ **F. C. Whiteside,** formerly division engineer of the Northern Division, has been appointed assistant chief engineer of the Interstate Oil Pipe Line Company. Whiteside is being succeeded as division engineer by **Sam Phelps,** formerly an engineer in the Northern Division engineering department specializing in mechanical problems and design. Both men will remain in the company's home offices in Tulsa, Oklahoma.

The assignment changes are a part of Interstate's program to strengthen the engineering staff and make available to the operating divisions a well rounded group of technical men. Under the organization plan, major engineering functions have been assigned to the expanded staff engineering department headed by **Joe C. Rawlins,** chief engineer. **E. C. Mishou** will remain in Shreveport, Louisiana, as division engineer for the Southern Division.

▸ **John Lamb** has relinquished his position as manager of the technical division of the Marine Department of The Anglo-Saxon Petroleum Company, Ltd., to organize and take charge of a new department concerned with marine research and development. His new title is manager of marine research and development. **A. Logan** has been named to succeed Lamb in the Marine Department. **W. J. Brown** replaces Logan as head of the repair and maintenance sections. **Capt. H. B. Russell** has been appointed a joint manager of the shipping division, and **Capt. D. Williams** has been made acting head of the marine staff and crew sections.

▸ **Edgar G. Hill,** for many years a vice president and director of Ford, Bacon and Davis, New York City, has retired from active service but will continue in the capacity of consultant.

▸ **W. C. Taylor,** Southern Division material and traffic manager of the Interstate Oil Pipe Line Company, upon completing 40 years' continuous active service with affiliates of the Standard Oil Company (New Jersey), was honored with a dinner party in the Washington-Youree Hotel, Shreveport, Louisiana, recently. Symbolic of his four decades of services, Taylor was presented by Loren F. Kahle, president of Interstate, with the traditional gold service button bearing three diamonds. The ceremonies were witnessed by a group of his close friends and associates headed by S. W. Day, Shreveport, Southern Division vice president of Interstate, and Mrs. Day.

Taylor's is the fifth 40-year button to be awarded by Interstate. Of the others entitled to wear this emblem, only S. W. Day is still on active employe status. The others now retired, include J. A. Kunkle, Shreveport; R. C. Walker, Tulsa; and A. C. Beckner, Jenks, Oklahoma.

Phillips Petroleum Company Buys Pipe Line System

K. S. Adams, president of Phillips Petroleum Company, announced today that Phillips Pipe Line Company, a wholly-owned subsidiary, has purchased all assets of the Longview Gathering System, Inc., which includes 48 miles of trunk lines and gathering lines in the East Texas field.

These lines are primarily in the north portion of the East Texas field and will be operated in connection with Cordova Pipe Line System, which is in the south end. Adams said. "This system will provide pipe line facilities for connecting to leases whose oil production has recently been offered to Phillips Petroleum Company. It will also make possible the purchase of additional oil throughout the length of the East Texas Field."

Will Handle Advertising for Standard Pipeprotection, Inc.

Oakleigh R. French and Associates, St. Louis, Missouri, has been appointed by Standard Pipeprotection, Inc., of the same city to handle its advertising. This is a new organization offering streamlined facilities for applying protective coatings to steel pipe at St. Louis in transit between pipe mills and delivery points. G. Gordon Hertslet is account executive.

FPC Orders Emergency Service Regulations for Middle West

The Federal Power Commission ordered that the emergency service rules in effect last winter governing deliveries of natural gas by Panhandle Eastern Pipe Line Company to its customers in the Middle West should be put into effect again for the coming winter. Under the commission's order the rules became effective on November 1 and remain in effect until April 30, 1949, unless changed by the commission for good cause shown.

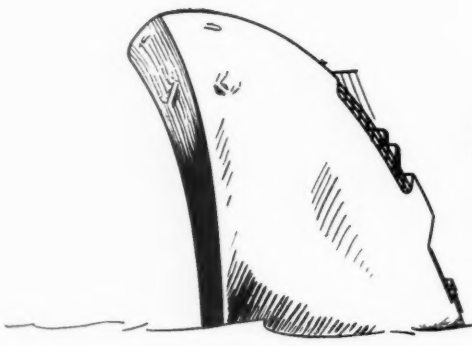
The Commission's action followed hearing in Washington, D. C., on October 21 at which Panhandle and the companies dependent upon the Panhandle system were given an opportunity to show cause why the commission should not by order establish for the coming winter the same emergency service rules and regulations that were in effect during the winter season of 1947-48 with such modifications, if any, as required in the public interest.

To Build Employe Residences

Contracts have been let by The Texas Pipe Line Company for the immediate construction of 22 residences for employes in the Wichita Falls and Midland areas, it was announced by R. B. McLaughlin, president of the company.

The ABC Construction Company of Wichita Falls was awarded the contract to build 11 cottages and garages at the Wichita Falls tank farm on the Jal, New Mexico,-Cushing, Oklahoma, pipe line.

A contract was given the Mid-West Lumber Company of Midland to erect 11 cottages and garages at the Midland tank farm on the same pipe line.



MARINE OPERATIONS

Britain Shipyards Building Three Large Tankers for Shell

The keels of two of Shell Oil Company's three 28,000-ton deadweight tankers that are to be built in Britain —the largest to be constructed in that country—have been laid. The first was laid July 20 in the Swan, Hunter shipyard at Wallsend-on-Tyne and the second, September 16, by Harland & Wolff at Belfast. The keel of the third vessel is expected to be laid next February by Cammell, Laird.

The new 28,000-ton tankers, which will be of advanced design incorporating the most modern standards of crew accommodations, will carry cargoes of crude oil from the Middle East, principally from Shell's new refineries at Shellhaven in Essex and at Stanlow on the Manchester Ship Canal. The three new tankers will be oil-fired and are expected to be in service in 1951.

Oil Docks at Brownsville

The Port of Brownsville, Texas, has completed and placed in operation a 500-ft oil dock. A second dock of the same dimension is scheduled for completion November 15, and a third December 15. All three docks are situated on 32 ft of water along the north side of the Brownsville Ship Channel. Each dock consists of a "T" shaped creosoted timber wharf with a loading and working platform 108 ft by 28 ft fronted by a row of seven clusters of 21 pilings each 65 ft in length.

F. W. Hofmokel is general manager and director of the port.

Add Nine Tank Barges

Nine more tank barges have been added by Ashland Oil and Refining Company, Ashland, Kentucky, to the fleet of 15 now under construction at Dravo Corporation's shipyard in Pittsburgh. The second contract calls for nine articulated tank barges identical in design to the fleet previously ordered from Dravo.

Operating as a single fleet, the nine steel barges will be towed three abreast and three deep. The three leading units will be built with shaped bows and square, box-like sterns; whereas the three aft units, interchangeable with the others, will have square bows and shaped sterns. The middle units, with square bows and sterns, will be integrated between the leading and aft units. The fleet will look like a tow of three single barges.

This new fleet design eliminates water turbulence at the points where the barges join, adding to towing efficiency.

Each barge will be 195 ft by 35 ft by 10 ft 10 in. and will have a crude oil capacity of 420,000 gal.

To Improve Caracas Harbor

A survey of the Port of La Guaira, port for the capital city of Caracas, Venezuela, has been completed and detailed recommendations made on construction projects and equipment for improving harbor facilities. Presented to the Venezuelan government, the report and survey were made by the Ibec Technical Services Corporation. At the same time it was reported that the Mexican government received plans for the reconstruction of wharves and docks at the port of Tampico. Included in modernization plans will be the installation of new material handling equipment on the wharves.

40 Esso Tankers to Have Radar

Placing of contracts for radar sets to be installed on 40 of its seagoing tankers, has been announced by Standard Oil Company of New Jersey. Arrangements have been completed for the purchase of 20 sets each from Radiomarine Corporation of America and Sperry Gyroscope Company, as the first step in its program to equip 90 vessels of Esso's American Panamanian flag fleets with radar.

Marine radar equipment to be installed under the present contracts utilitizes new postwar designs that are especially prepared for commercial vessels, according to M. G. Gamble, general manager of the marine department of Standard Oil. The sets operate on a frequency band of 9320-9500 megacycles and are fitted with 12-in. viewing screens. A Radiomarine radar set has been under test aboard the *Esso Paterson* and a Sperry set aboard the *Esso Parkersburg*. With the adoption of this new advance in navigational aids, Standard Oil Company of New Jersey becomes the world's largest user of commercial marine radar.

Stresses Petroleum Carriers

A 600-hp tugboat and two 3700-ton oil-tank barges were added recently to the Volga River fleet upon delivery from the Krasnoye Sormovo shipyard, near Gorki, USSR. From the Mordovschikovo yard (Gorki Province) comes the report that there is now under construction a 6000-ton capacity petroleum tank river barge, 428 ft long. Already delivered are four seagoing petroleum barges of 5000-ton capacity for use at the port of Astrakhan.

Increased speed with which these vessels are reported to have been completed is credited to mechanization of a number of operations formerly performed manually, use of subassembly methods, standardization of parts, and use of automatic electric welding instead of rivets.

New Tanks, Improved Docks

Improved supplies of home-heating oil for the Connecticut and Rhode Island areas this winter are assured in an announcement by the Socony-Vacuum Oil Company, Inc., that it has leased two new tanks with a combined capacity of more than 10,000,000 gal at Groton, Connecticut. The tanks were leased from the Ballard Oil.

In addition, according to Socony-Vacuum, dock facilities at the Groton distribution center are being dredged to a new depth of 35 ft to accommodate Socony-Vacuum tankers, which will transport the home-heating oil from refineries in Texas.

From Groton, the home-heating oil will be relayed by barges to other bulk plants in New England between Providence, Rhode Island, and New Haven, Connecticut, to provide larger supplies and more regular deliveries to those places.

Socony-Vacuum officials said the

Groton tanks were leased as a temporary measure until sufficient steel can be obtained for construction of new tanks elsewhere in Connecticut and New England as part of the company's long-range program of modernization and expansion to meet increased demands for home-heating fuel.

Lubricating Oil Barge

Lake Tankers Corporation of New York has ordered one 8900-bbl lubricating oil barge from Dravo Corporation, Pittsburgh. A hopper-type unit, 240-ft by 40-ft by 12-ft in size, the barge will have six cylindrical oil tanks installed in the hopper space and will be equipped with heating coils, piping, and pumping equipment.

British Yard Schedules Two Tankers for Norway

A tanker of 23,000 tons deadweight has been ordered from John Crown & Sons, Ltd., Sunderland, England, by Olsen & Ugelstad of Oslo, Norway. This will be the largest ship ever ordered at Sunderland, according to a report contained in a recent issue of "The South African Shipping News and Fishing Industry Review." The vessel is to be launched in two sections with delivery scheduled for 1951. Also from Sunderland comes the report of an order booked by Sir James Laing & Sons, Ltd., to build a motor tanker of 23,000 tons deadweight for Leif Hoegh & Co., A/S, Oslo. The keel for this vessel will be laid in 1950 with launching scheduled for 1951.

Todd Converting Six LST's to Oil Tankers

Todd Shipyards Corporation has been given the contract to convert six LST's into crude oil carriers for Shell Caribbean Petroleum Company, according to advice from the ship repair company's New York office. The Brooklyn division has already begun work on four former tank and troop landing ships Nos. 180, 198, 200, and 319, and the Hoboken Division is well along on the identical conversion of Nos. 345 and 137. All will fly the Venezuelan flag.

The six vessels, when modified for commercial use, will serve as crude oil carriers on the shuttle run between Lake Maracaibo, Venezuela, where the oil fields are located and the new Shell refining plant at Cardon, which will be put into service in the near future. They will make the 300-mile round trip in approximately 60 hours, will carry 28,000 bbl of crude oil each.

The specifications provide for installing 17 oil cargo tanks and four water ballast tanks in what was formerly mostly runways for mobile armored tanks. They also call for the installation of new deckhouses, which will contain the quarters for 36 officers and men, two galleys and messrooms. New steel smoke stacks, 9 ft 6 in. high, will be installed.

The vessels will be scraped, scaled, and wire-brushed to the bare steel and repainted—deep red below the light water line, with the usual anti-fouling and anti-corrosive coats; black hull, white superstructure and buff stacks with the Shell emblem.

It is expected that the conversions will be completed by February, 1949. When they leave New York for Cardon, Venezuela, on their maiden voyage, it is planned to have them carry fresh water to the refinery, which normally has to import it.

Award Winning Ideas

Three seamen in the Marine Transportation Department of the Socony-Vacuum Oil Company, Inc., divided several hundred dollars recently for award-winning ideas under the company's new suggestion system.

Hubert Coyle of South Tenth Street, Newark, New Jersey, a boatswain on the Socony-Vacuum tanker *Conastoga*, won awards of $25 and $65 for suggestions to improve the rigging for cargo booms and for installing gratings over equipment used in cleaning barges.

Daniel Ronspees of Cleveland (Oswego County), New York, a mate on a powered barge, the *New Haven Socony*, received $85 for suggesting a flashlight bracket on measuring tapes for gauging the contents of tanks aboard the vessels.

Charles Sheridan of Amboy Road, Tottenville, Staten Island, New York, an engineer on the Socony-Vacuum tanker *Millspring*, was awarded $70 for the proposed use of a special electric voltage tester to be used on deep-sea vessels.

McEwen to new post

Paul J. McEwan, formerly supervisor of ships' pursers in the Port of New York office of the Marine Department of the Standard Oil Company (New Jersey), has been appointed assistant chief of U. S. marine personnel. As assistant to T. J. Lyons, chief, U. S. Marine Personnel Section, Port of New York office, he will cooperate with K. A. Wichelns, also assistant to Lyons.

Lafayette Fisher, Jr., who has been head of the Tax and Machine Record Unit of the Ship's Payroll Audit Section at 115 Broadway, has been chosen to succeed McEwan as supervisor of ships' pursers.

Oil Cargoes Must Be Moved In American Flag Tankers

Countries participating under the Marshall Plan have been notified by the Economic Cooperation Administration that all future ECA oil cargoes from the United States must be moved in American flag tankers. Agency figures show that of 301,000 tons of oil shipped from this country under European aid program only about 69,000 tons or 23 per cent, have been moved in U. S. flag tankers. The law specifies that a minimum of 50 per cent of cargoes from U. S. must be hauled in American ships.

Launch 30,000 Ton Tanker

Described as the largest tanker ever built, the 30,000 ton *Bulkpetrol* was launched recently by Welding Shipyards, Inc., at its Sewells Point yard, Norfolk, Virginia. Constructed for Oceanic Tankships, S. A., New York, the new tanker is said to have a service speed of sixteen and a half knots. Vital statistics are: length 629 ft 8 in.; beam, 84 ft; designed draft, 33 ft 4 in.

Motor Tanker Jalta Completed

The motor tanker *Jalta*, the first of an important group of tankers that Harland and Wolff, Ltd., are building for Norwegian owners, has been completed at the company's Belfast yard. A/S Bulls Tankrederi, of Sandefjord, are the owners. Main dimensions of the *Jalta* are as follows: length overall, about 487 ft 6 in., length b.p. 460 ft; breadth moulded, 59 ft; and depth moulded 34 ft 10 in.; with 12,000 tons deadweight on a draft of 27 ft 6 in.

Orders four tankers

The Eagle Oil and Shipping Company, Ltd., has recently ordered four 15,000-ton tankers of turbo-electric propulsion. Three will be built by Furness Shipbuilding Company, Ltd., and the fourth by Harland and Wolff.

New Tanker Company

World-Wide Tankers, Inc., of Los Angeles, California, recently put into commission the Liberty-type tanker *John Goode* to operate along the Pacific Coast, with ports of call at Seattle, Tacoma, Portland, Stockton, Richmond, and San Pedro. World-Wide Tankers transports petroleum products for its parent firm Time Oil Company, an independent oil company having deepwater terminals at principal West Coast ports. President of the new company is H. H. Whitesel, formerly district manager at Wilmington, California, for the Hillcone Steamship Company.

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